OCTOBER 17, 1960

American Machinist / Metalworking Manufacturing

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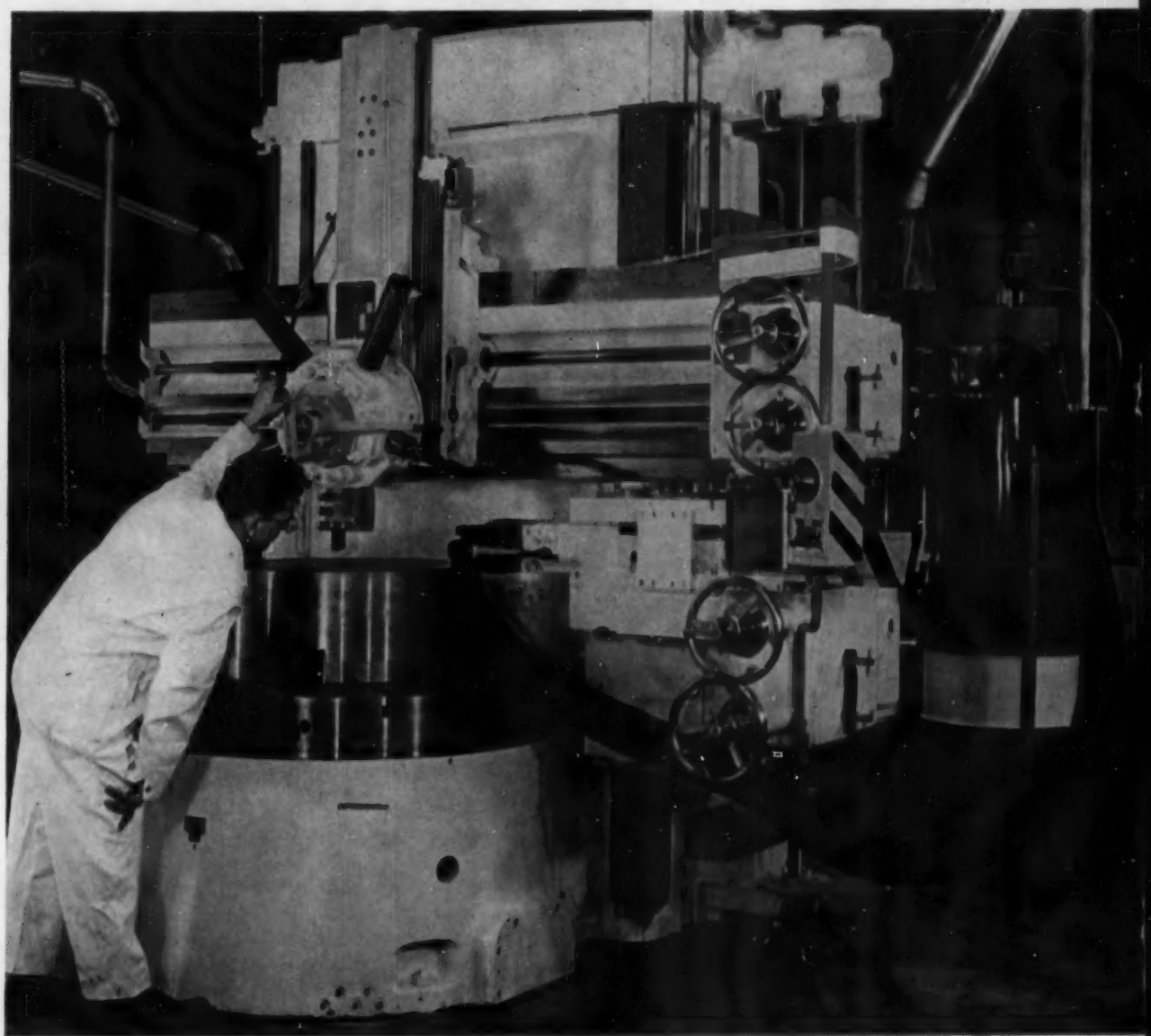
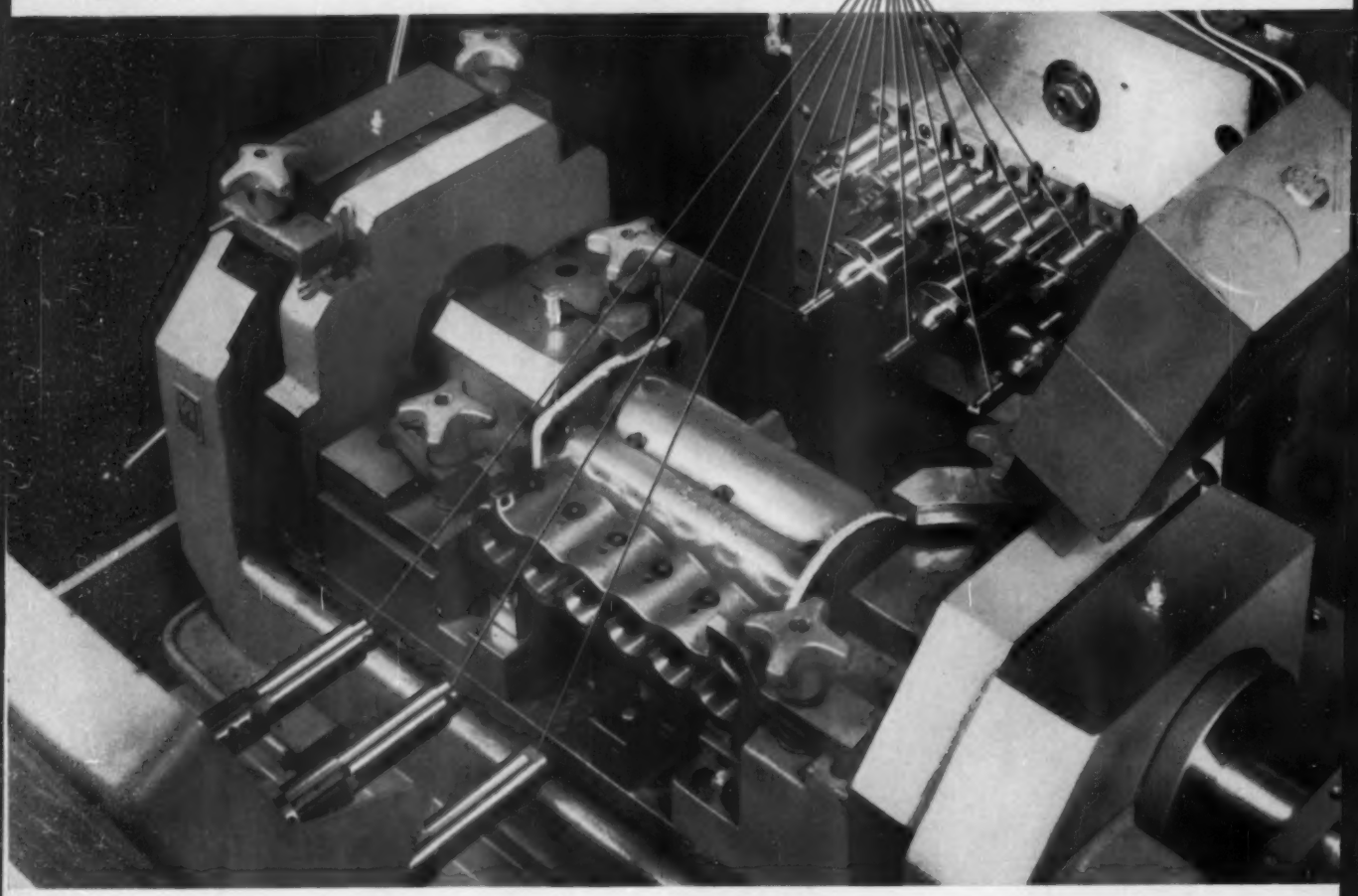


Suction and special tools machine beryllium—see Special Report, page 115

Machine requirements for the Space Age, page 101

14 Steps to design a die: BLANK DEVELOPMENT, page 108

12 HEADS
are better than one



Heald Bore-Matic finishes up to 27 DIFFERENT SURFACES at a single loading

• In the setup shown above, 27 surfaces of 15 bores are done on one machine at a single loading—a Heald Model 222 Bore-Matic with Multi-Spindle heads with a trunnion type fixture. Six deep 3-step bores are done with the three left-hand heads with only one index of the cross slide. After indexing the fixture to hold the work vertical, nine right-angle bores are done at a single pass with the right-hand heads. The same machine also handles four-barrel pump housings, simply by removing one of the left-hand spindles and three of the right-hand spindles.

On multiple-hole Borizing jobs such as this, interchangeable Multi-Spindle Red-Head boringheads permit many operations to be combined on a single machine, with minimum indexing of the work and positive spacing between bores. Your Heald engineer will be glad to give you complete information.

It PAYS to come to Heald

THE HEALD MACHINE COMPANY

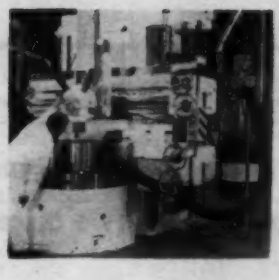
Subsidiary of The Cincinnati Milling Machine Co.
Worcester 6, Massachusetts

Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • Milwaukee • New York • Philadelphia • Syracuse

HEALD ®

CIRCLE 151 READER SERVICE CARD

COVER:
Shiny white paint on Bullard VTL at Beryllium Corp shows up any toxic dust. See page 115.



American Machinist / Metalworking Manufacturing

contents for October 17, 1960

VOLUME 104, NO. 21

Let's catch up with the Space Age! . . . A report on machine tool requirements of the aircraft and missile industry. *By John R Condit, Convair Div, General Dynamics* 101

Inexpensive gage checks ID of small holes . . . Naval Ordnance Lab device is accurate to within 0.0002 in. 102

Finish those rolls in less time! . . . Practical tips on roll grinding with belt setups. *By Robert A Leggett, Behr-Manning Co* 103

Long-armed welder reaches "inaccessible" spots . . . How to exert a squeeze at the end of a long boom 106

14 Steps to design a die . . . Step 13, part 2 of this informative series covers blank development for bent and formed parts. *By J R Paquin* 108

Italy—and the industrial renaissance . . . The story of the real "sleeper" among Europe's metalworking nations. *By Gene di Raimondo*..... 112

Volkswagen: how they do what they do . . . Otto Hoehne, production manager talks about methods at Volkswagen 114

SPECIAL REPORT NUMBER 498

Production man's guide to working beryllium . . . Despite limited availability, high cost, manufacturing problems, and toxicity, more and more shops are finding they need to know how to handle it. Here is a review of good practice covering machining, forming, and joining. *By George Toczko and Ken Breeze, The Beryllium Corp* 115

REFERENCE BOOK SHEETS

One-stroke rim holes. I, II, III . . . The tooling and formulas for producing flanged holes in one operation. *By David M Bauer* 131

TURN PAGE FOR METALWORKING REPORT—►

Trends . . .

Metalworking Report . . 2
Spot News . . 83
Washington . . 85
Detroit . . 87
Aircraft and Missiles . . 89
Machine Tools . . 91
Materials . . 93
What's Ahead . . 95

Departments . . .

Letters . . 74
Calendar . . 77
Editorial . . 99
Talking Shop . . 137
Practical Ideas . . 138
Names . . 141
New Materials . . 145
New Equipment . . 149
Field Report . . 185
New Films . . 226
New Books . . 228

METALWORKING REPORT . . .

. . . what's new and significant in manufacturing techniques and materials—direct from our own staff and round-the-world news bureaus

FORMING . . . One-weld spheres that become rocket-engine chambers are being built by ACF Industries with steel 0.080 in. thick. The shells, each a half chamber, are cold-deep-drawn in four stages at a 4000-ton press; final size is 38 in. deep and 54 in. in diameter, weight is 250 lb. This eliminates the usual seams on conventional rolled-and-welded cases. Annealing, phosphating, and heat-treating steps are included to keep wall thickness uniform and produce final strength of 210,000 psi. The single seam weld around the periphery joins the two halves.

INSPECTION . . . A new reliable test of brittle missile steels has been developed by Stanford Research under Aerojet-General sponsorship. This replaces destructive tests where production parts had to be put under pressure to see if minute cracks developed, and it prevents weakening production parts that pass the stress tests. The technique starts with a sample of the hard, strong missile steel; the sample is slotted by spark machining on one side. Then a steel stud is driven by explosive charge into the opposite side of the sample. The laboratory then analyzes the resulting fracture. Advantage: Test conditions can be standardized, any test can be repeated exactly, and valid comparisons can be made without breaking up production parts.

WELDING . . . Plasma torches cut twice as deep in stainless steel and aluminum when voltage and gas flow are increased. The Heliarc cutting torch will penetrate 4-in. stainless at 5 ipm when 160 volts and 700 amps are applied, and with 300 cfh of gas flow. High gas flow also produces dross-free cuts in stainless up to 1½ in. deep, thus eliminating costly chipping operations. The new maximum depth for cutting aluminum is 5 in. Report was given at the AWS fall meeting by Geidman and Bott of Linde.

CUTTING . . . HSS drills cut three times as many holes when 17-4 Mo stainless is held at 300-350 F, according to Cincinnati Milling's second report on high-temperature machining (AM/MM—Jul 11 '60, p 117). Tungsten-carbide twist drills were unsuccessful at high temperatures. In turning, tool life was improved 40 times by heating 600 Bhn Thermold J die steel to 800 F. Cemented-carbide single-point tools cut at 500 fpm.

CUTTING . . . Sintered-carbide cutters beat cermets or oxides for face milling high-strength alloys at elevated temperatures, the Cincinnati report continues. Optimum radial rake angles are from 0 to -7°, with axial rake at -7°. Dubbing the cutting edges to produce slight lands did not help—in fact, it reduced tool life.

ASSEMBLY . . . Adhesives simplify die castings and make it possible to use complicated designs without paying a manufacturing penalty. Minnesota Mining cites an example from a pump manufacturer who joins three relatively simple die castings to produce a complex assembly. The adhesive bonds are made with an epoxy formula that eliminates lugs, bolt holes, and flanges. Parts are sand blasted, then coated with adhesive. Mating casting faces are not to close tolerances.

FINISHING . . . Polar coatings can boost fatigue strength 600% in magnesium alloys, 250% in copper-beryllium alloys, and 200% in steel, according to research by National Bureau of Standards. The coatings are long-chain organic materials (12 carbon atoms per molecule) such as octyl alcohol and dodecylamine. The polar atomic groups apparently attach to the metal surfaces to act as a barrier to water and oxygen. The technique works poorly on aluminum and stainless because of interference by the natural oxide coatings they have.

MANUFACTURING CONTROL . . . Get the lead out with random people samples, says an aircraft parts manufacturer, who has increased his effective use of productive labor by 16%. Trained observers enter the plant at random times, making head counts of who's working and who's idle. Repeated observations produce valid work-idle ratios that show labor performance in weekly reports. Full details of the system, at the Aircraft Div of Twin Coach Co, Buffalo, N Y, in a forthcoming issue.

FORMING . . . Convair saves $10.00/lb titanium in hot-forming dies by cutting blanks to exact size, then welding on aluminum tabs for electrode attachment. Parts to be formed used to be blanked oversize so they would extend beyond forming dies and electrodes for resistance heating could be attached. Two workers at the plant recently won $7953 for suggesting the tab treatment. The cheaper aluminum conducts electrical energy for internal resistance heating while the parts are in the dies.

INSPECTION . . . "Industrial inspection kit" is just what the doctor ordered for looking into deep, small, and virtually inaccessible cavities in tools, dies, and machines; and it is actually patterned after a medical probe, mirror, and midget-lamp kit. The probes are rigid and flexible, with fixed and movable mirrors, magnifiers, and battery-powered lamps. Elements are interchangeable and interlocking. The kit is by Ellis Optical Co, Thornton Heath, Surrey, England—costs $84.

Continued on next page

Coming in AM/MM

Organizing for Numerical Control

How Rohr Aircraft set up for programming

METALWORKING REPORT . . .

ASSEMBLY . . . First ultrasonic weld inspection in the auto industry is applied by Chrysler Corp at Twinsburg, Ohio, to all unit bodies. Floor pans are joined to ladder frames on the longest automated welding assembly line built to date. All spotwelds on all cars are inspected by a new method developed for the relatively thin sheet metal.

MATERIALS . . . Bigger molybdenum sheets, 105 x 48 in. by 0.060 in. thick, are now available on mill order from Refractomet Div, Universal-Cyclops. These will allow production of large parts with fewer welds, brazes, or riveted overlaps, and should help fabrication of larger rocket-motor components.

FINISHING . . . Portable electropolisher works up small areas, such as metallographic samples or complex contours, to high finish. The Jacquet Ellopol (France) development has a stainless-steel head covered with glass fiber soaked in electrolyte, and fed current by a small rectifier. Dabbing or light rubbing finishes the metal surface. The stylus is water cooled and operates from 50 volts at 1/5 amps maximum.

MATERIALS HANDLING . . . Stop 'runaway' gravity conveyors with a flow retarder developed by Rapistan-Keystone for its overhead power-and-free conveyor system. It is an air-powered, switch-controlled device that works especially well on long storage lines for heavy or fragile parts. A load entering the storage section trips a switch, and air pulsates rubber-faced plates up and down against the conveyor trolley brackets. This slows down a loaded trolley to the speed of an unloaded trolley.

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CIMTROL

Mr. E. J. Rivoira, manager of the new CIMTROL *Division*

CINCINNATI MILLING ANNOUNCES CIMTROL DIVISION

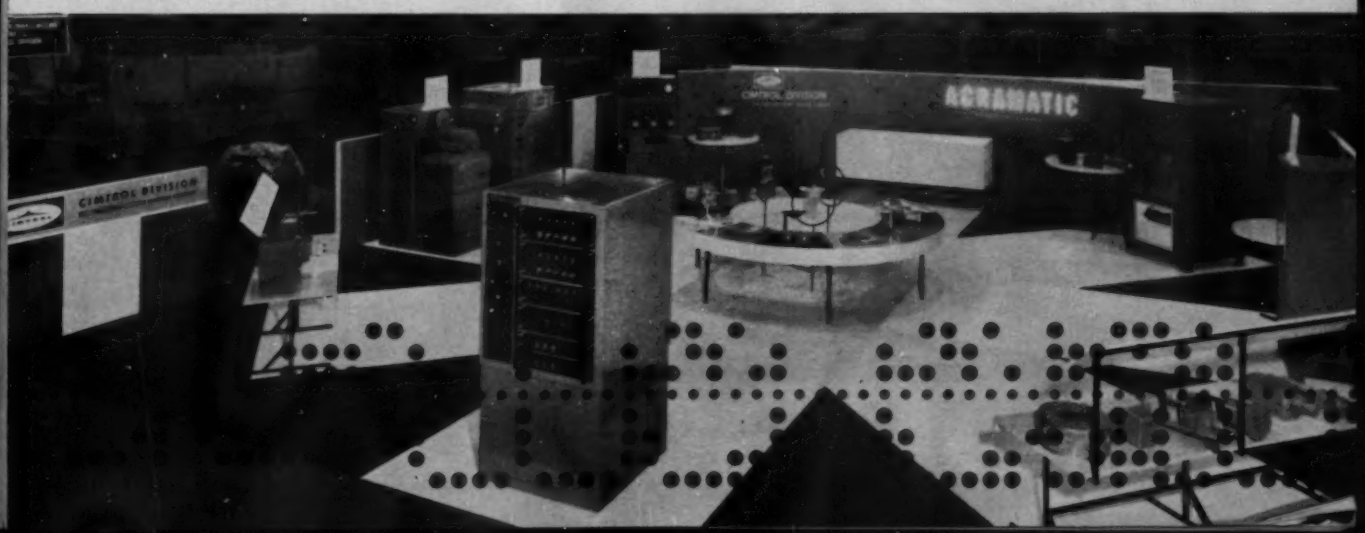
More than 30 years ago The Cincinnati Milling Machine Co. pioneered in the use of hydraulics for milling machine control. This basic method of control led to the development of many unique types of hydraulic, electronic and electro-hydraulic controls and systems—with applications in milling, grinding, die sinking, broaching and special machines built by Cincinnati.

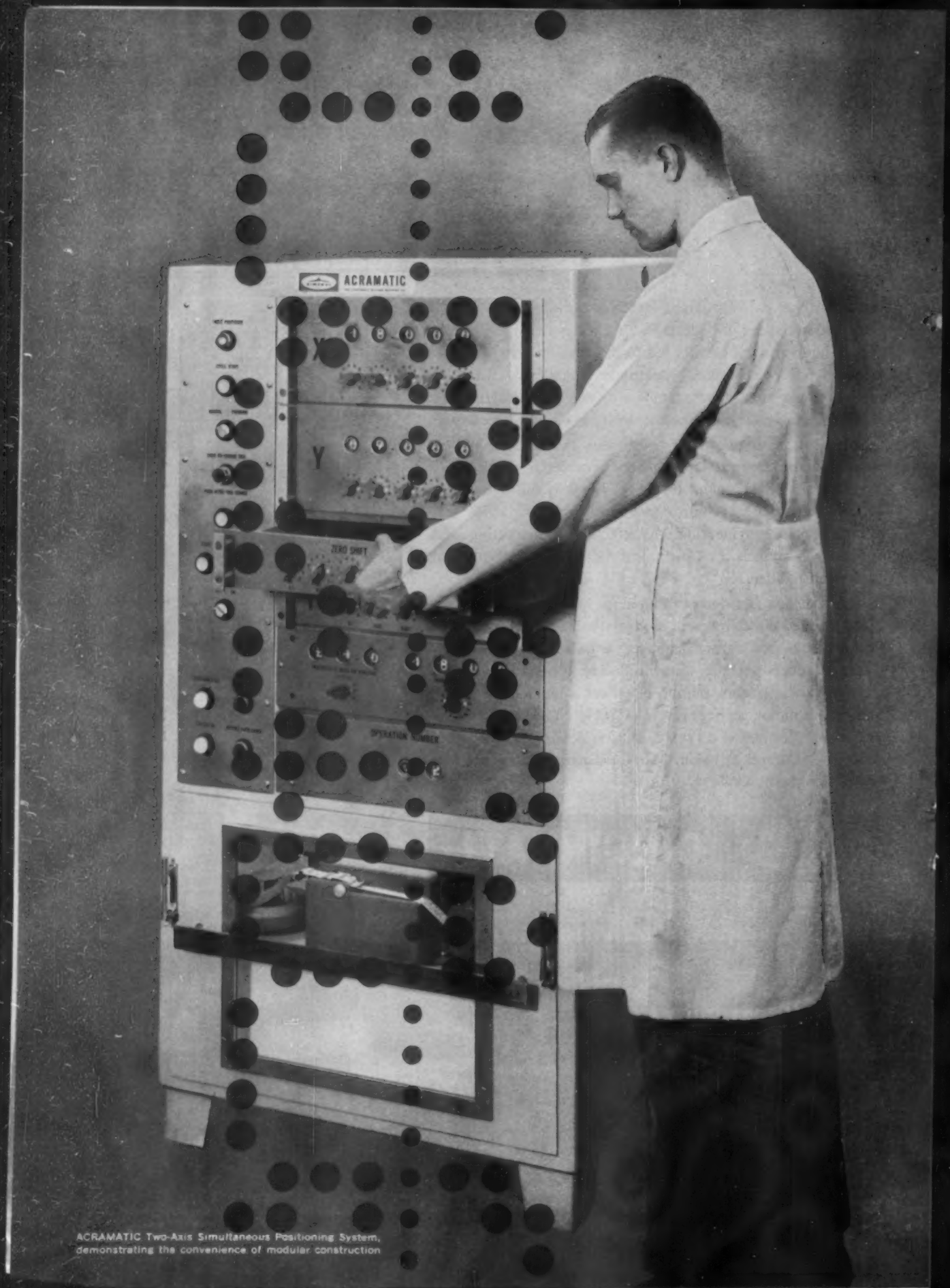
So important is this technology today that Cincinnati has established the CIMTROL Division (compounded from the words "Cincinnati Milling" and "control"). The only full line manufacturer of machine control systems, this new Division is responsible for engineering, manufacturing, marketing and servicing of controls for Cincinnati Milling and other original equipment builders.

The CIMTROL Division's exhibit at the Machine Tool Exposition presented three groups of products: ACRAMATIC Numerical Control; ACRATRACE tracing systems; ACRASIZE gaging systems. Other products include many different types of hydraulic motors, valves, tracers, pumps, electrical equipment items . . . and programming services for ACRAMATIC Numerical Control. For more information on CIMTROL turn now to the two pages following. **Cimtrol Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

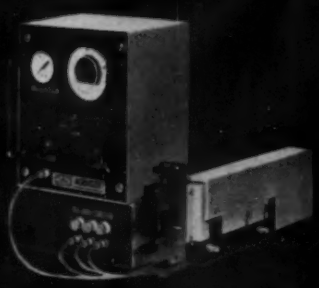
CIMTROL CINCINNATI®

The most significant exhibit at the recent Machine Tool Exposition . . . CIMTROL *Division's display of controls for original equipment builders*





ACRAMATIC Two-Axis Simultaneous Positioning System, demonstrating the convenience of modular construction



ACRASIZE "Jump-on" Gage System

ACRATRACE three dimensional tracer mechanism

ACRAMATIC Contouring System feedback unit

CINCINNATI

THE NEW ORDER OF MACHINE CONTROL SYSTEMS

Cincinnati Milling engineered automatic controls on milling machines as long ago as 1912. The first unit was an automatic cycle feed box. This was followed by many other innovations, all designed to increase productivity, accuracy or automaticity.

Today a whole new order of mechanisms is built by the CIMTROL Division to govern the operation of machines. These control systems perform not just one, but many functions, integrating a variety of operations into a single cycle. They accomplish many tasks unimagined by the machine designer of 1912 . . . detecting sizes within a few millionths of an inch . . . transmitting commands with the speed of light . . . stopping moving members in exact position for loading and unloading unsymmetrical parts . . . converting pulses of light into electrical control of machine slide movement.

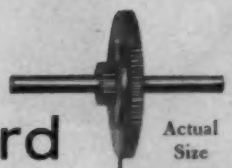
Cincinnati's new CIMTROL Division is dedicated entirely to this new order of machine controls, a few of which are illustrated here. Original equipment builders are invited to present their machine control problems to Cincinnati. CIMTROL Division engineers have the background to work out the best solution. **Cimtrol Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

CIMTROL **CINCINNATI**

ACRAMATIC NUMERICAL CONTROL SYSTEMS • ACRATRACE TRACING SYSTEMS • ACRASIZE GAGING SYSTEMS

CIRCLE 156 READER SERVICE CARD

now you can check & record fine-pitch gear accuracy



at 1600 magnifications

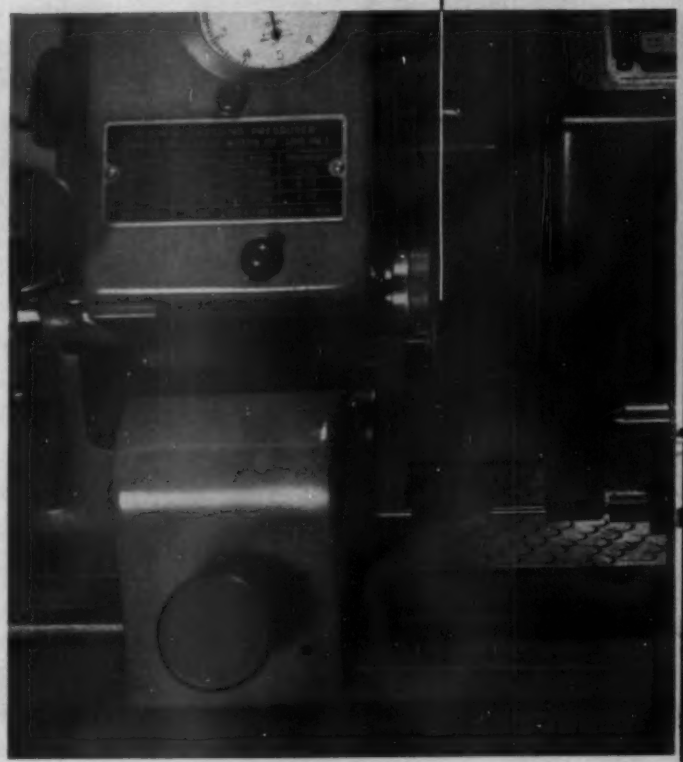
on the No. 4 Fellows Red Liner

Now, the No. 4 Red Liner makes "composite" checks on the finest instrument gears with unbelievable accuracy and sensitivity. 1600 to 1 magnifications are obtained with the electrical recording system which gives a written, unbiased record for instant reading or for proof-of-accuracy files.

One report states — "11 teeth, 200 D. P. pinion backed up to a 100 tooth gear on a cluster, checked easily on the No. 4 Red Liner."

The job shown is 96 pitch with 22 teeth on the small gear and 80 teeth on the larger gear. The pinion shaft rides in vees in a turret-type fixture.

Fellows inspection units cover a range from the tiniest instrument gear up to some that are 24 inches in diameter.



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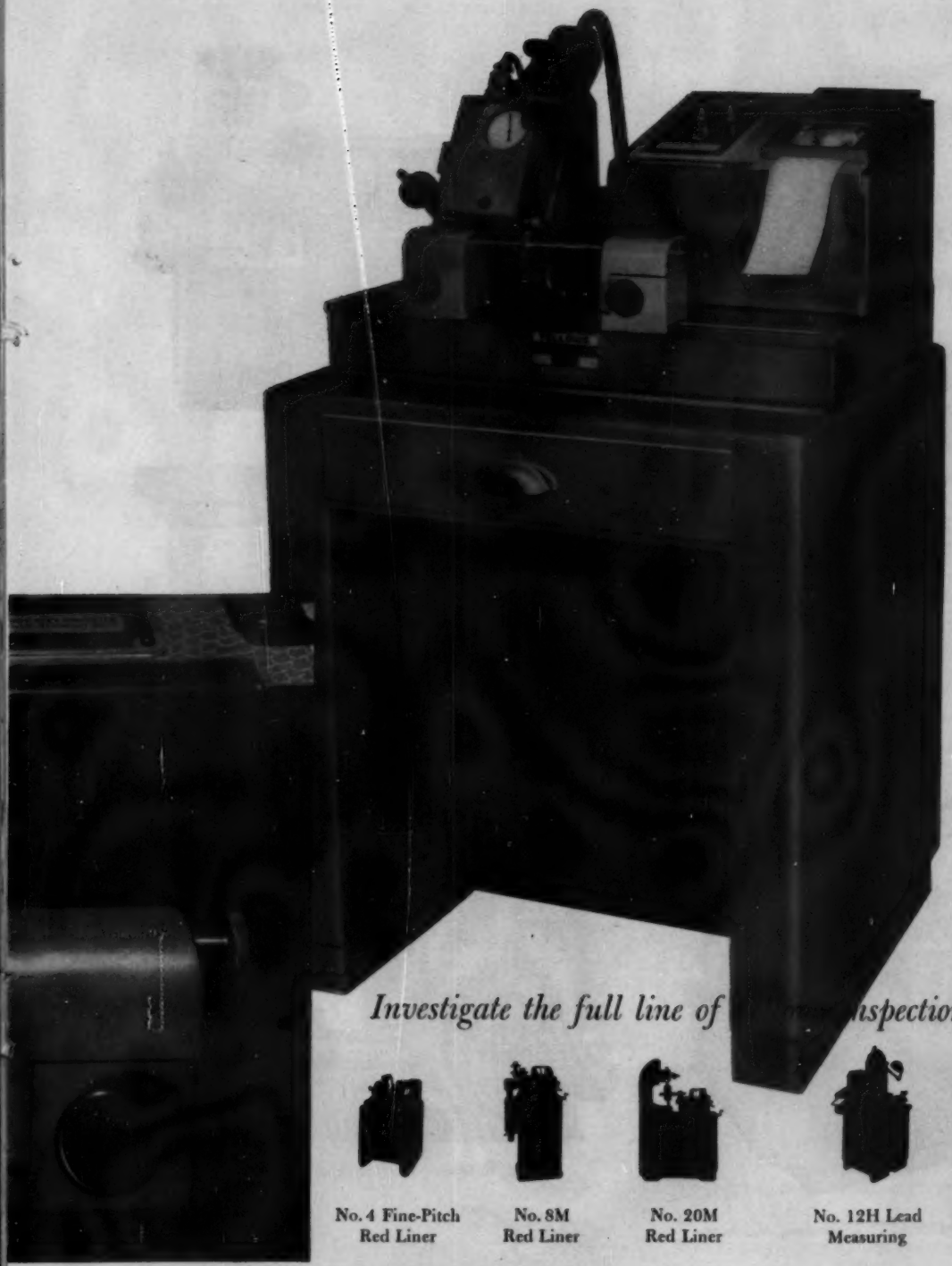


Investigate the full line of [illegible] *inspection equipment*

No. 4 Fine-Pitch Red Liner

No. 8M Red Liner

No. 20M Red Liner

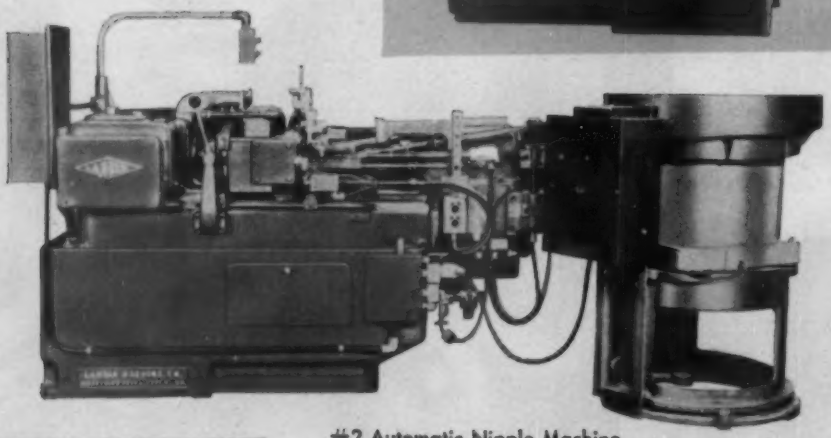
No. 12H Lead Measuring

No. 12M Involute Measuring

THE PRECISION LINE

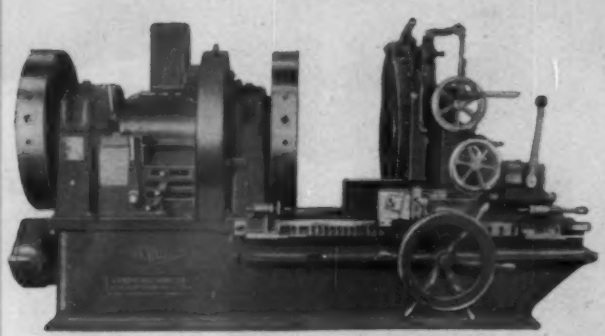
Fellows *Gear Production Equipment*

LANHYROL Thread Rolling Machine



#2 Automatic Nipple Machine

12 Double LANDMACO Threading Machine



8⅝" Receding Chaser Pipe Threading Machine

Threading Machines

Die Heads—Rotary & Stationary

Taps—Collapsible & Solid Adjustable

Centerless Thread Grinding Machines

Thread Rolling Tools

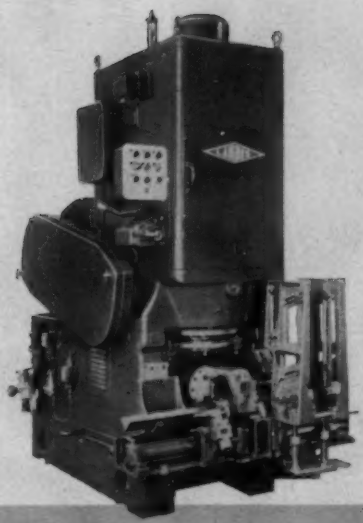
Thread Rolling Machines

THE WORLD'S LARGEST MANUFACTURER OF THREADING EQUIPMENT

How would you choose a **threading machine?**

Would you consider the results to be obtained first? Or, would you consider how much it's going to cost first? Perhaps your first thought would be to check on the reliability of the manufacturer. Could be you are strictly a name-brand buyer.

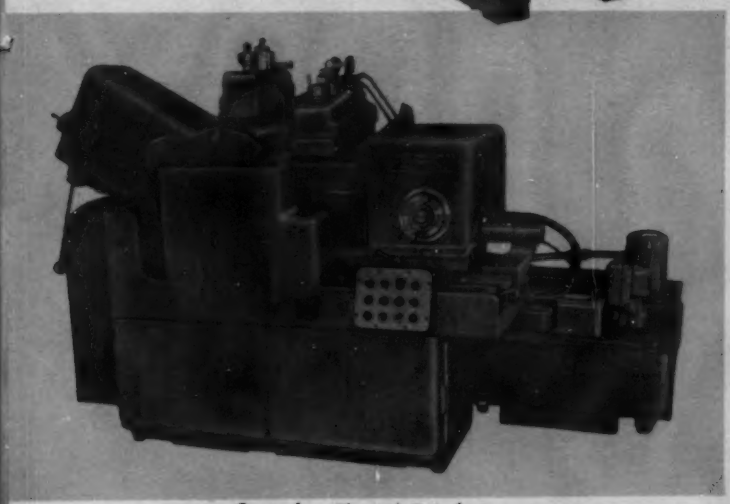
Maybe you choose a threading machine because it has been recommended by a satisfied user such as the Landis Machine Company customer who realized a 90% saving in time threading power screws on a LANDMACO Threading Machine.



48TA Coupling Tapping Machine

How **you** would choose a threading machine of course only you can answer. But doesn't it make good sense to buy from a world leader such as the LANDIS Machine COMPANY? All kinds and sizes of threading machines, thread rolling machines, pipe and nipple threading machines, thread grinders, pipe threading and cutting machines, and automatic coupling tapping machines to meet every threading requirement are available from Landis.

To put the accumulated knowledge of our over 55 years in the threading field to work for you is as close as your phone.



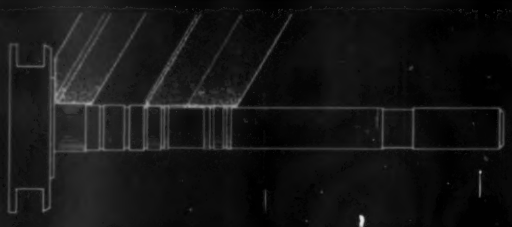
Centerless Thread Grinder

LANDIS *Machine* COMPANY
WAYNESBORO · PENNSYLVANIA

new

Landis R plunge

automatic production grinder



New Landis R Plunge Grinder automatically grinding 3 diameters and face of 100 transmission shafts per hour with dependable accuracy.

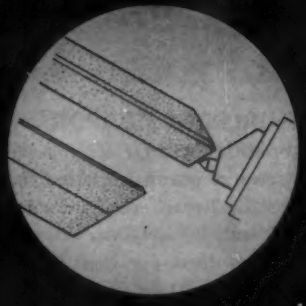
grinder

for consistent "tenths" tolerances

...completely new concept in production grinder design now gives you these new features for lower production costs

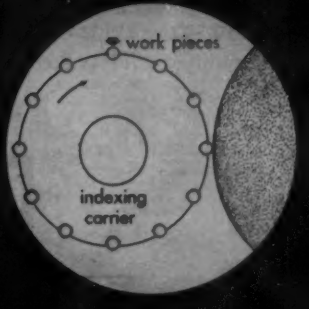
Landis MICROFEED—a new feed, symbolized by this mark, that guarantees "tenths" tolerances on a production basis

- automatically compensates for wheel wear and machine temperature variations
- eliminates costly rejects and reworking
- easy-to-set feed reduces set-up time



TRUFORM—a new dresser for accurate duplication of the profile to the wheel

- mounted on pre-loaded steel balls, to keep friction to a minimum for easy movement and accurate dressing
- dresses profiled wheels with angles up to 60°
- pushbutton control assures uniform dressing cycles



NEW Landis design assures stability and convenient maintenance

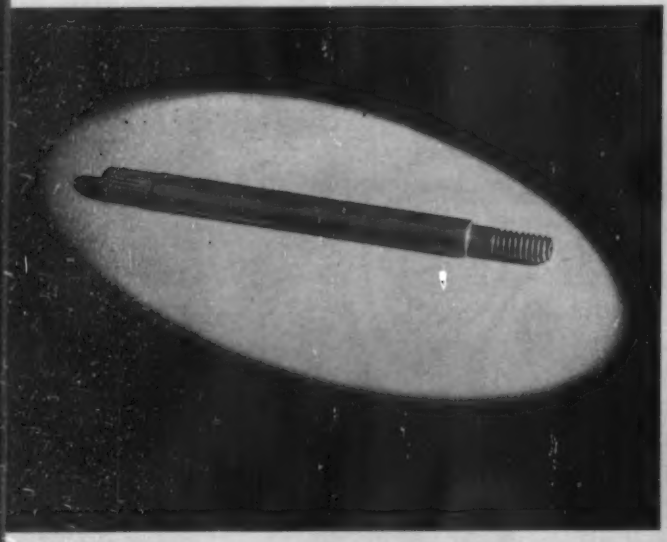
- new design box bed allows use of high production indexing rotary loader
- coolant, oil and valves outside bed
- automatic lubrication
- meets J.I.C. electrical and hydraulic standards
- automatic lateral location of work

LANDIS

precision grinders

LANDIS TOOL COMPANY WAYNESBORO, PENNSYLVANIA

HIGH MACHINABILITY



WHIRLPOOL CORPORATION uses .314" diameter Republic Cold Drawn Stainless Steel Bars (Type 416) for water pump impeller shafts in 1960 RCA Whirlpool Dishwashers. Shafts are turned and threaded on one end, knurled on the other, cadmium plated, and pressed into die cast impellers. Republic produces more than 40 standard types of stainless steel. Send for these free booklets: (1) HOW TO FABRICATE . . . (2) HOW TO WELD . . . (3) HOW TO MACHINE . . . Republic Stainless Steel.

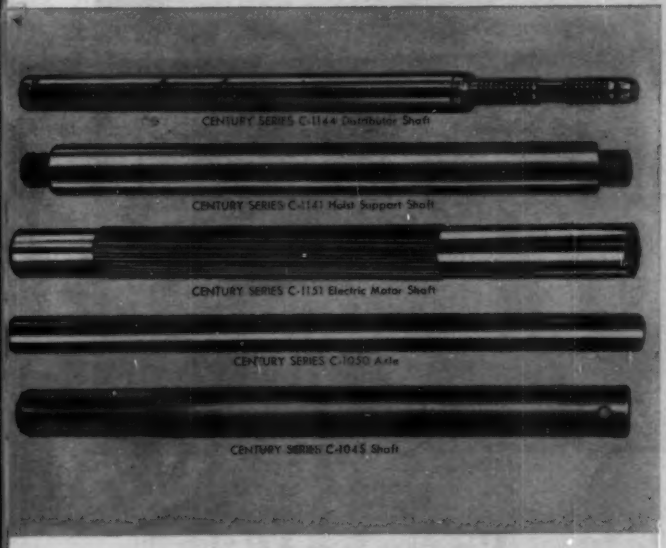
THE CRANE CO. used Republic Titanium in the production of valve components for Freeport Nickel Company's new $119,000,000 nickel-cobalt processing facilities. Titanium was cut, ground, tapped, spot welded, heat treated, and hand forged. Use of Republic Titanium permitted close-tolerance machining with considerably fewer rejects than anticipated. Titanium metallurgists help you select and apply the grade best suited for your needs. Send for data.

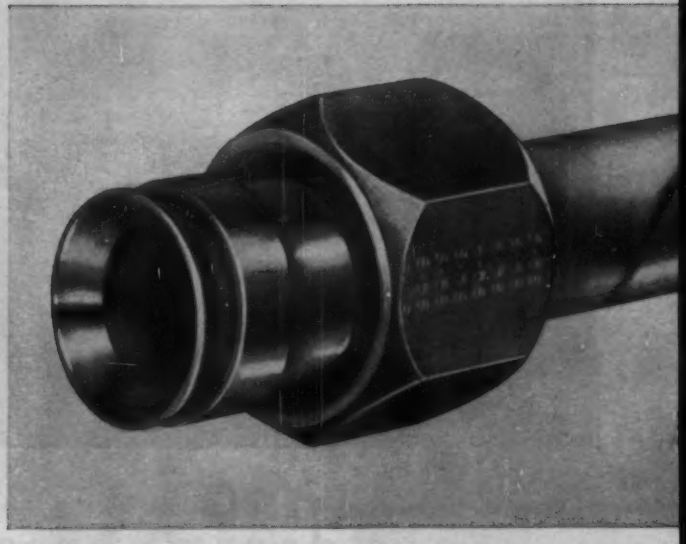
3-DIMENSIONAL METALLURGICAL TEAMS:

Republic's mill, field, and laboratory metallurgists and machining experts help you select and apply the metal best suited to requirements. Mail coupon for details on this confidential, obligation-free service.

CIRCLE 163 READER SERVICE CARD

(for Whirlpool... for Crane...for you)


CENTURY SERIES C-1144 Distributor Shaft
CENTURY SERIES C-1141 Hoist Support Shaft
CENTURY SERIES C-1151 Electric Motor Shaft
CENTURY SERIES C-1050 Axle
CENTURY SERIES C-1045 Shaft



YOU SPECIFY DEGREE OF MACHINABILITY when you select from Republic's CENTURY SERIES. There are five grades: C-1045, C-1050, C-1151, C-1141, and C-1144. Each offers minimum yield strength of 100,000 psi. For parts needing little machining, better strength-to-toughness ratios are often obtained with one of the *less expensive*, lower sulphur grades. Send for your free copy of Republic's CENTURY SERIES Booklet.

HUNDREDS OF EQUIPMENT BUILDERS have switched to Republic ELECTRUNITE® Hydraulic Fluid Line Tubing. This *welded* tubing is easier to flare and bend . . . meets or exceeds the normal life of tubing produced by any other method . . . offers appreciable savings in initial cost. Available in all sizes shown in the JIC Standards Book. ELECTRUNITE is made from close-tolerance, flat-rolled steel. Checked for defects as only flat-rolled steel can be checked. Send coupon for copy of specifications.

REPUBLIC STEEL

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

CIRCLE 164 READER SERVICE CARD

REPUBLIC STEEL CORPORATION
DEPT. AM-9977
1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send:
- ☐ STAINLESS STEEL BOOKLETS (How to fabricate . . . weld . . . machine)
- ☐ CENTURY SERIES BOOKLET
- ☐ SPECIFICATIONS FOR ELECTRUNITE HYDRAULIC FLUID LINE TUBING
- ☐ INFORMATION ON METALLURGICAL AND MACHINING ASSISTANCE

Have a metallurgist call:
☐ Stainless Steel ☐ Titanium ☐ CENTURY SERIES

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

So it doesn't break---*So what??*

So we can bend a MARVEL High-Speed-Edge Hack Saw Blade double, and it won't break. Does this prove anything?

Let's see if it does. When you buy a box of hack saw blades, you expect each blade to have a reasonable cutting life. For example, take an ordinary blade that costs $4.00, and you expect it to produce 2000 sq. inches of accurate cutting-off before it is discarded. Would you be willing to pay $8.00 for that same blade? *You will, if it breaks halfway through its expected life.*

Bending a MARVEL High-Speed-Edge Hack Saw Blade to demonstrate that it is truly unbreakable proves the point that you get every square inch of blade life you pay for when you buy MARVEL Blades.

Safety to both operator and machine, plus maximum blade life, seem like value enough from this remarkable blade. However, these MARVEL Blades give you even more, for they will cut faster, with greater accuracy because they can be safely tensioned more taut in your machine than ordinary "breakable" blades and are therefore more rigid to resist deflection.

Cost? Unbreakable MARVEL High-Speed-Edge Hack Saw Blades are priced competitively. Use MARVEL Blades consistently with complete confidence because they have no equal for value. Leading Industrial Distributors stock and sell MARVEL. Ask yours today.

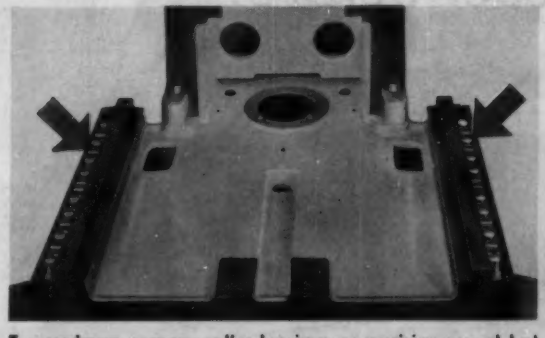
ARMSTRONG-BLUM MANUFACTURING CO.
5700 West Bloomingdale Avenue • Chicago 39, Illinois

MARVEL Metal Cutting SAWS
Better Machines-Better Blades

For precision and ease of operation

The only 618 surface grinder with roller bearings on both table and saddle bed ways

Antifriction roller bearings on precision ground table ways give easy operation. Work is always contained between saddle ways.



For maximum accuracy roller bearings on precision ground bed ways minimize the rise and fall caused by oil film build-up.

specifications—Landis Abrasive 618

Worktable capacity	6" x 18"
Standard wheel diameters available	7" or 12"
Capacity under 7" wheel	14½" to table
Capacity under 12" wheel	12" to table
Spindle drive motor: 7" wheel	1 hp
12" wheel	2 hp
Net weight	1,820 lbs.

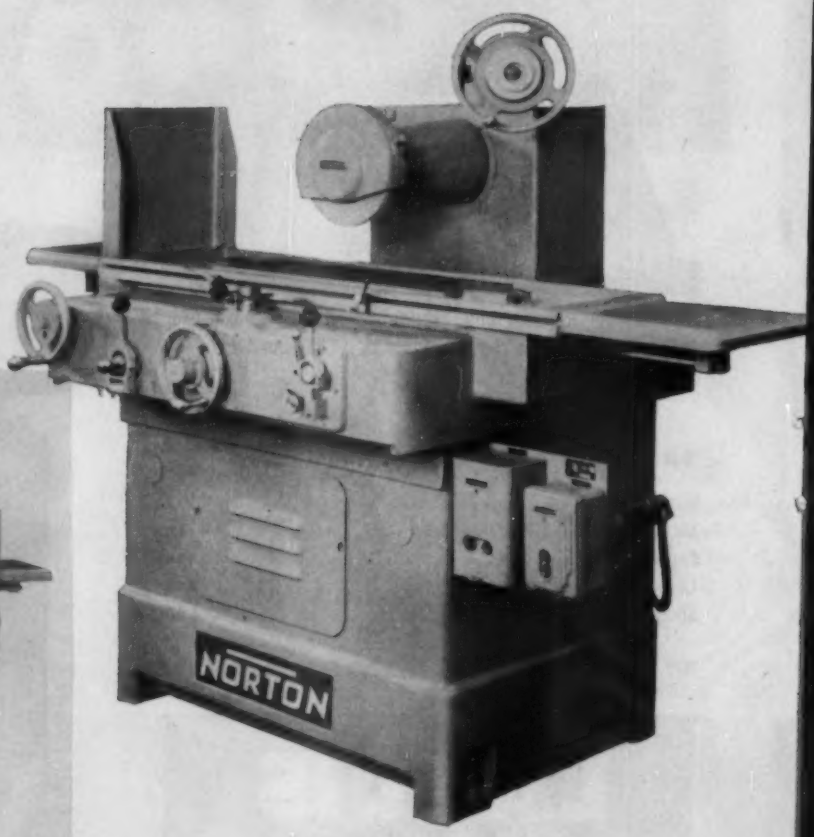
LANDIS
ABRASIVE
precision surface grinders

Landis Tool Company, Waynesboro, Penna.

Now... **Type S-3 surface with 150** *fpm* **table**

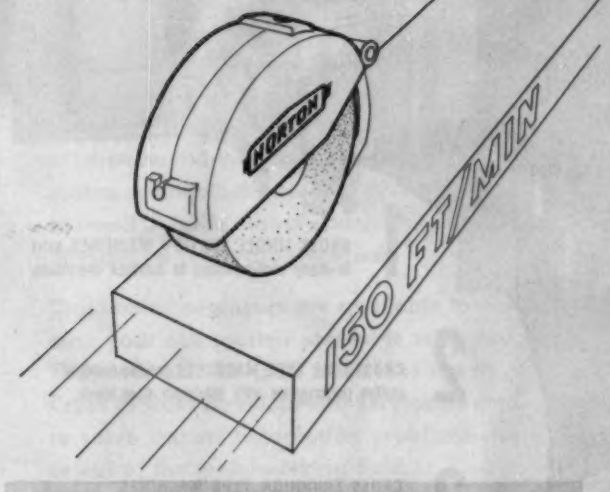
for faster production than ever before!

Available in 6" x 18" and 8" x 24" sizes. Both sizes are equally fast, cool, accurate on long production runs or a wide variety of toolroom grinding. Taller workpieces are easily handled by the 15" vertical capacity of the 6" S-3, and 13¾" capacity of the 8" S-3 Grinder. Other job-proved features include a two-speed .0001" increment hand wheel, assuring accurate vertical speed and fast positioning . . . contoured splash guards, for better sighting and loading.



NORTON PRODUCTS: Abrasives • Grinding Wheels • Machine Tools • Refractories • Electro-Chemicals — **BEHR-MANNING DIVISION:** Coated Abrasives • Sharpening Stones • Pressure Sensitive Tapes

grinders speed...



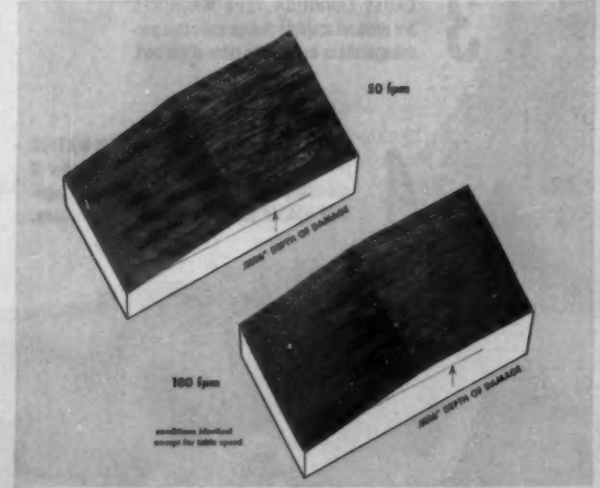
Long popular for their pace-setting table speeds up to 125 feet per minute, Norton Type S-3 surface grinders have given complete proof of their ability to finish workpieces smoother, faster, at lower cost.

Now S-3 grinders are also available with table speed stepped up to a new high of 150 feet per minute — enabling you to finish flat faster than ever, with cool-running action that saves time and money on every job.

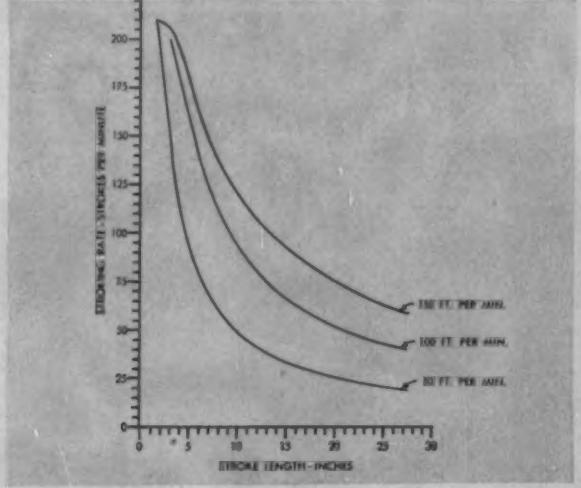
Get the whole story from your Norton Man, a trained specialist who can help you get better grinds at lower cost. Or ask for Catalogs 1982 and 2128. NORTON COMPANY, Machine Tool Division, Worcester 6, Mass. District Offices: Worcester, Hartford, Cleveland, Chicago, Detroit. *In Canada:* J. H. Ryder Machinery Co. Ltd., Toronto 5.

NORTON
MACHINE TOOLS

75 years of... Making better products
...to make your products better



You Get Better Quality Work with Norton Type S-3 surface grinders, thanks to their faster table speeds, which reduce heat damage. The above test samples show how faster table speeds result in cooler grinding.



Calculate Your Savings from this production rate chart. Grinding time is reduced in proportion to the increase in stroking rate. The higher speeds also greatly increase the rate of stock removal.

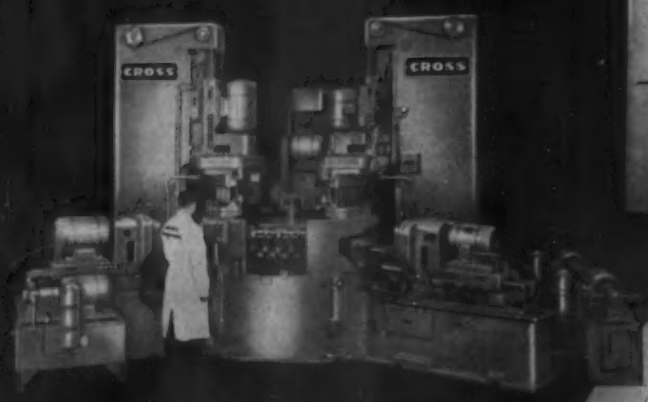
MACHINE TOOL DIVISION: Grinding and Lapping Machines — G & E DIVISION: Shapers • Gear Cutting Machines • Gear Induction Hardeners

▲ CIRCLE 168 READER SERVICE CARD

CIRCLE 169 READER SERVICE CARD ►

6 ways to automate

Cross automation takes many forms . . . from the simplest low production machines to complex equipment for mass production.

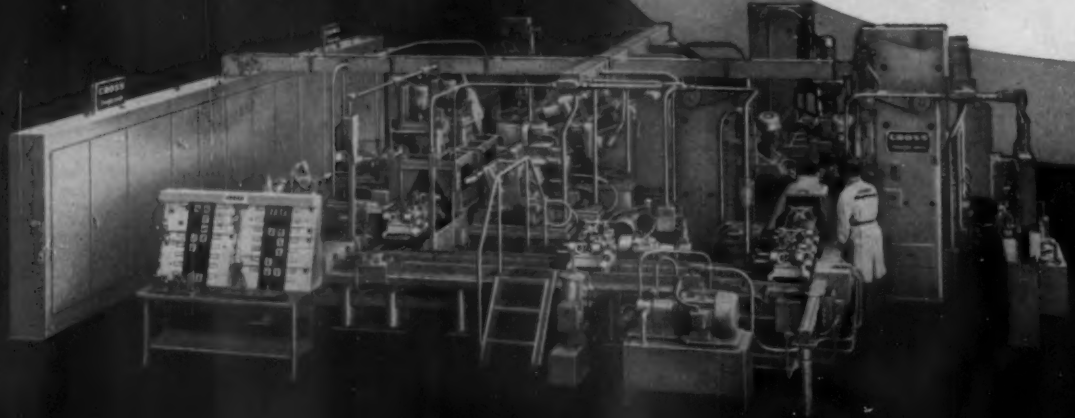


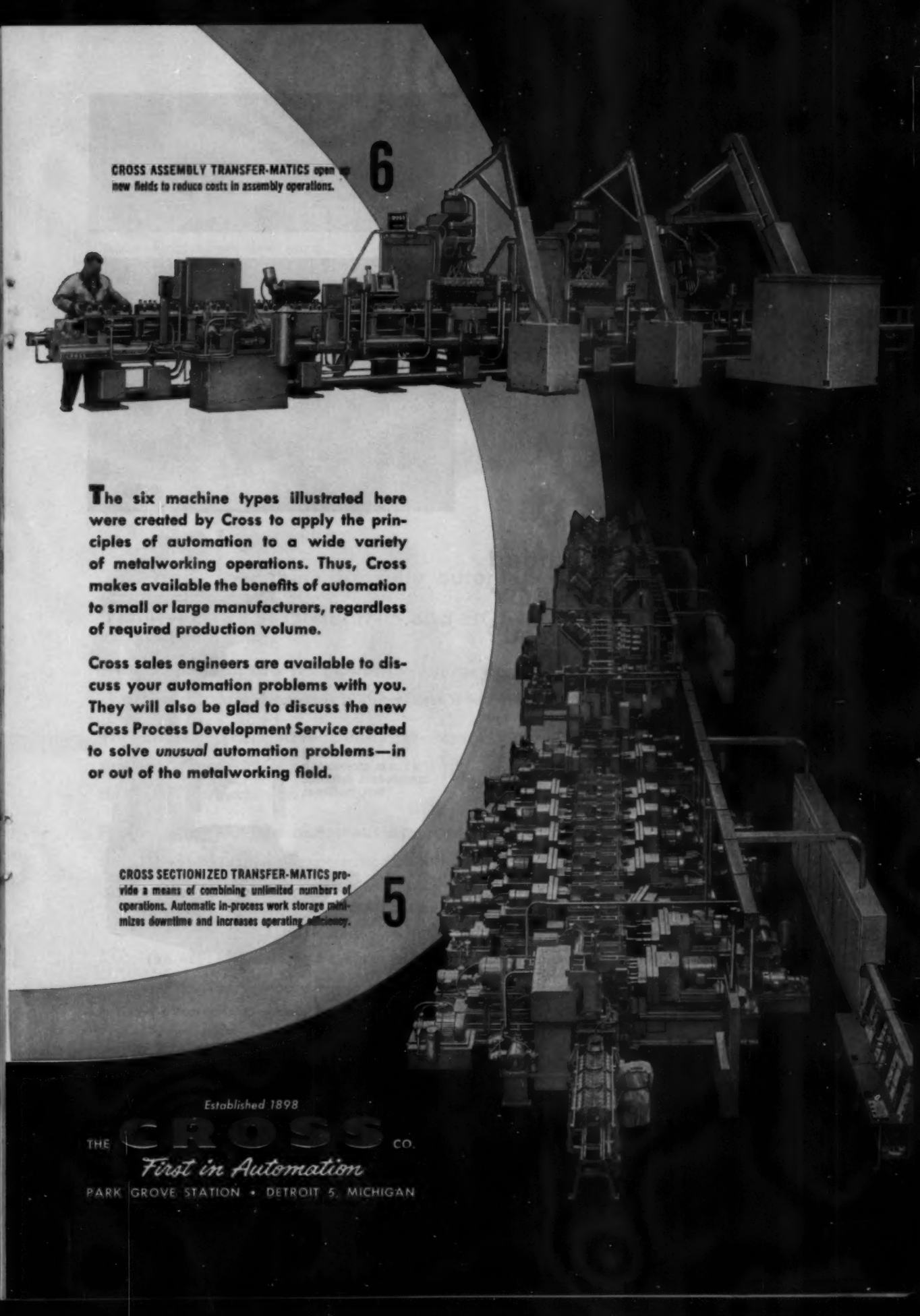
1 **CROSS SINGLE STATION MACHINES** exist in many configurations to combine operations.

2 **CROSS DIAL TYPE MACHINES** provide multiple station performance with minimum floor space.

3 **CROSS TRUNNION TYPE MACHINES** are compact multiple station units that permit operations on opposite sides of the part.

4 **CROSS PALLET TYPE TRANSFER-MATICS** provide capacity for combining a large number of operations. Standard pallet fixtures handle irregularly shaped parts with maximum flexibility.





CROSS ASSEMBLY TRANSFER-MATICS open new fields to reduce costs in assembly operations.

6

The six machine types illustrated here were created by Cross to apply the principles of automation to a wide variety of metalworking operations. Thus, Cross makes available the benefits of automation to small or large manufacturers, regardless of required production volume.

Cross sales engineers are available to discuss your automation problems with you. They will also be glad to discuss the new Cross Process Development Service created to solve *unusual* automation problems—in or out of the metalworking field.

CROSS SECTIONIZED TRANSFER-MATICS provide a means of combining unlimited numbers of operations. Automatic in-process work storage minimizes downtime and increases operating efficiency.

5

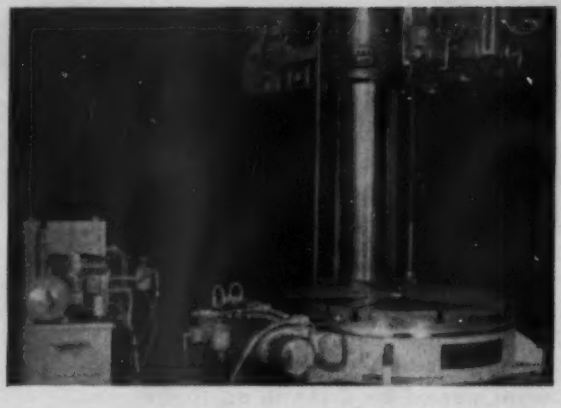
Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

It all started here! Indexing is so fine that it can only be checked optically, with an Auto Collimator.



Adaptations were inevitable! Here is the Rotomatic Positioner adapted to a standard radial drill.

Growth of an idea founded on ACCURACY . . . how can it benefit you?

This LAPOINTE brainchild began as a universal, automatic rotary indexing machine of *unprecedented accuracy*, for production work. It was built to take heavy loads — not necessarily balanced! — up to 50,000 pounds. Machine can start at *full load*. Designed for heavy drilling, milling, boring, inspection — and adaptable for broaching.

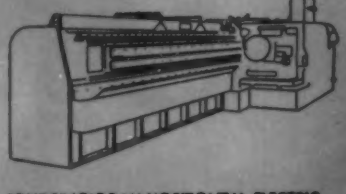
Indexing accuracy is guaranteed to within 5 seconds of arc of true position, and in use it will *repeat consistently*.

This shows how it was adapted to a Lapointe-built Automatic Hole Positioner.

Lapointe-built Broaching Machines are available in hydraulic and electro-mechanical drives.

60" STROKE HORIZONTAL, ELECTRIC

CH CONTINUOUS BROACHING, ELECTRIC



SRHE SINGLE RAM HORIZONTAL, ELECTRIC

◄ CIRCLE 170 READER SERVICE CARD

CIRCLE 171 READER SERVICE CARD

How the machine can be operated:

A. Tape controlled automatic positioning system.

B. Manual numeric — single cycle operation by dialing in information for each axis.

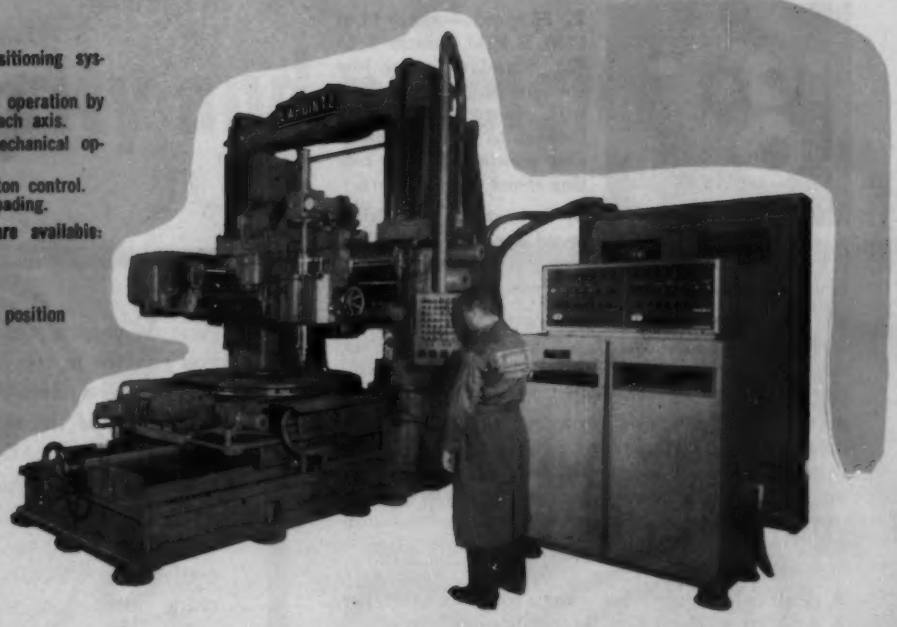
C. Automatic — through electro-mechanical operation.

D. Semi-automatic — by push button control.

In-and-out table provides ease of loading.

These five positioning tolerances are available:

X axis, ± .0005"
Y axis, ± .0005"
Z axis, ± .0005"
C rotary, 5 seconds of arc of true position
Depth of drill, ± .0005"



. . . and now this, the fully automatic, numerically controlled

LAPOINTE DRILLING and BORING MACHINE

Here's how you saw it at Chicago — at the exposition of the N.M.T.B.A. in the International Ampitheatre. Hundreds of others saw it too, and marveled at its *accuracy*.

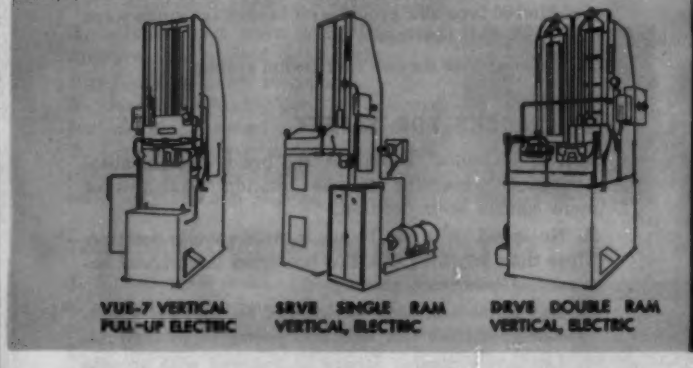
This amazing, rugged machine has tremendous possibilities in many shops . . . for saving production time, driving down production costs, causing substantial improvement in quality through *greater accuracy*.

Probably one of the numerous applications of this machine would be useful in *your* shop. Why not call in an experienced Lapointe Field Engineer and find out?

THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



VUE-7 VERTICAL PULL-UP ELECTRIC

SRVE SINGLE RAM VERTICAL, ELECTRIC

DRVE DOUBLE RAM VERTICAL, ELECTRIC

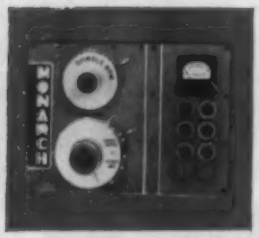
LAPOINTE

known to be the best in

BROACHING

the Monarch gage for

THE HEADSTOCK THAT THINKS... AND REMEMBERS



1. 36 speeds—range 14 to 1750 R.P.M.—ratio 1 to 125. Standard range low enough, high enough and with plenty of speeds in between to provide reasonably constant surface cutting speed on most work.

2. Optional extra-high speed range of 25 to 2500 R.P.M. available for free cutting metals such as aluminum and for ceramic tooling requirements.

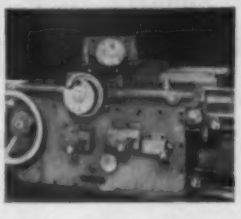
3. Operator works in terms of surface cutting speed. Machine automatically figures correct R.P.M. and sets up shift. Operator sets two large dials—one for work diameter, the other for desired surface speed.

4. Using the two-dial preselector, up to six or more different speed changes may be preset while machine is under cut. This saves speed change time when turning successive diameters having considerable variation or when finish turning immediately follows rough turning. The second dial always indicates spindle speed in engagement.

5. Pull of knob gives free spindle in a jiffy. And there is a generous $2\frac{1}{16}$" hole through the spindle.

6. Hydraulic brake and clutch are self-adjusting for wear. Being under automatic machine control regardless of load, operator need not supply power for engagement.

THE CONTROL CENTER OPERATORS LIKE



1. Series 62 is controlled by a three-position lever at the apron. A duplicate lever close to the headstock is provided for setup purposes. With it, work rotation may be started or stopped, jogging or speed change may be accomplished. In the SPEED CHANGE position the next speed is engaged automatically when preselection is used.

2. Shifting (an operation performed many times each day) is at finger-touch ease and speed. Hydraulic power does the work of clutching, braking, shifting and jogging.

3. Four-way power rapid traverse is in-built. Both carriage and cross slide traverse may be engaged simultaneously. This saves as much as 50% in tool adjust time.

4. Positive cam controlled feed frictions. Application is such that machine never loses its chip under heavy cuts.

5. Apron or headstock controlled leadscrew reverse, the former a must when much thread chasing is done.

ELECTRICALS WHERE THEY SHOULD BE

1. External main drive motor mounting and external electrical control mounting (either NEMA or JIC) for quick accessibility.

2. Motor mounted on hydraulic system sump from which position it also supplies power for hydraulic pump.

How do your lathes measure up? You get what you pay for in the purchase of a lathe, as with anything else. Greater production, therefore lowered costs, is the major reason for acquiring a new machine. That's what you get in the Monarch Series 62 Dyna-Shift—the only lathe of its general type which can be kept under full load during the entire machining cycle. Major contributing factors design-wise are more machine output per unit of power input, less operator effort, reduced maintenance and ease of supervision. See for yourself why the Series 62 meets all these requirements as does no other lathe on the market.

Users have found that these features and advantages have translated themselves into production increases of 25% or more and tool life improvement up to as much as 50%. And that's the pay-off. When you are ready to invest in a new lathe, buy the best. It's the cheapest in the long run.

THE MONARCH MACHINE TOOL COMPANY
SIDNEY, OHIO

COMPLETE AUTOMATIC LUBRICATION

1. Headstock, end gearing and gear box served by single system of the filtered, combination mist-splash type.

2. Apron lubrication system of the circuited, metered and filtered type also provides oil to carriage guide ways and cross slide bearings.

3. Tailstock has its own lubrication system.

INTERLOCKS FOR SAFETY

1. When motor is started, the brake engages automatically, preventing spindle rotation regardless of main control lever position.

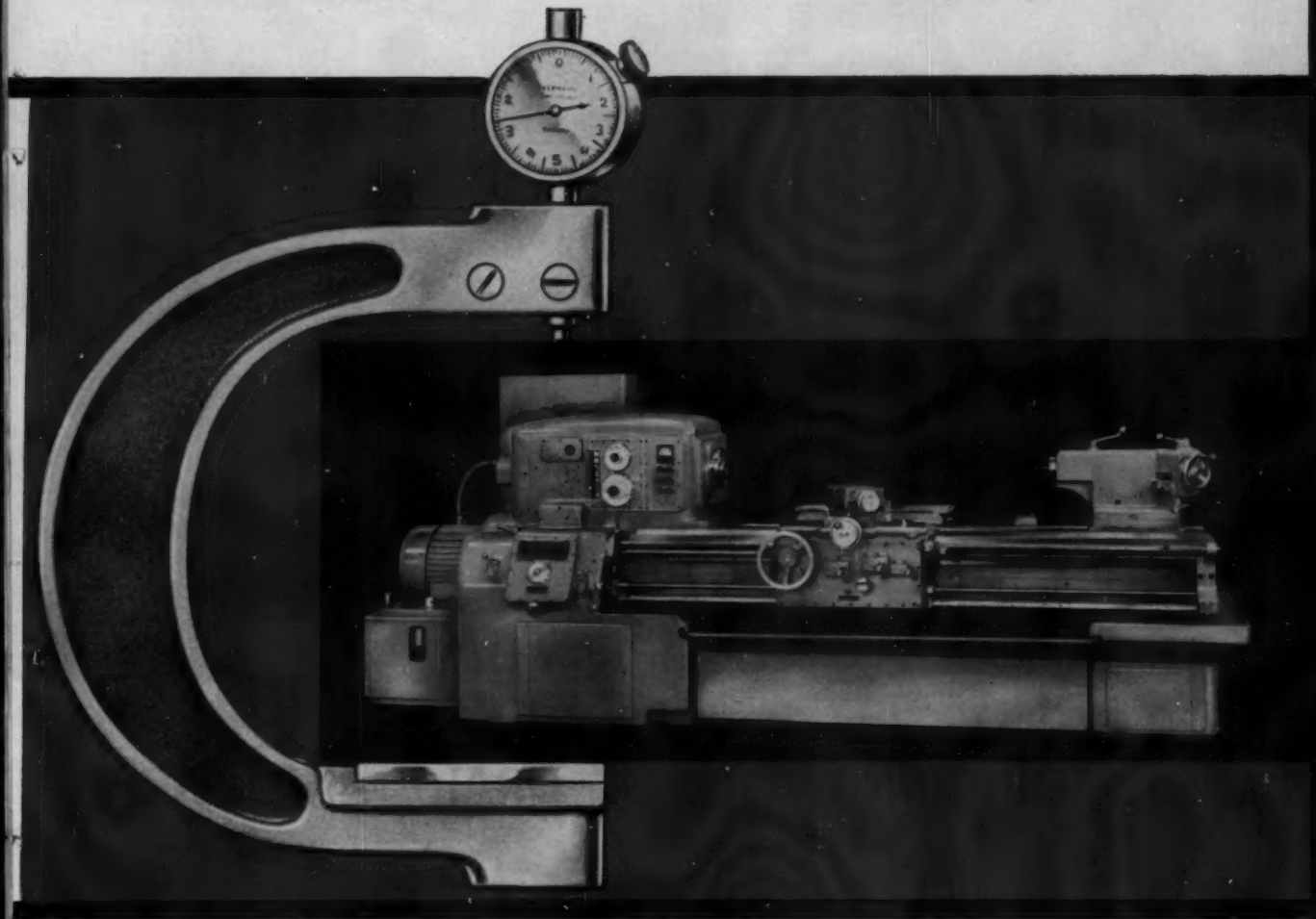
2. No speed shift can be made with spindle rotating. More than anything else this preserves the original accuracy of headstock gearing.

3. Leadscrew and feed rod cannot be engaged simultaneously; neither can feed and power rapid traverse.

4. Leadscrew reverse cannot be engaged with spindle rotating above 340 R.P.M.

CIRCLE 173 READER SERVICE CARD

series 62 lathe–
productivity and precision



PROTECTED GEAR BOX AND END GEARING

1. Gear box and end gearing totally enclosed. Lubrication is kept in, dirt kept out, original accuracy maintained.

THE BED...A FIRM FOUNDATION

1. All four bed ways flame hardened and precision ground to keep them factory-fresh for years to come.
2. Generous size chip pans are designed for easy chip removal at front or rear.
3. Longer machines equipped with traveling rod supports which are automatically picked up and dropped off by apron.

TAILSTOCK THAT MEANS BUSINESS

1. Either single speed or two speed range type available with dead or anti-friction center spindle. Sufficient mass and rigidity to support the heaviest of cuts.
2. Movement along bed manually or by power. This combination satisfies all turning conditions.

SUPERVISORY PROBLEMS SIMPLIFIED

1. At a quick glance, supervisor may check (a) work diameter setting, (b) SFPM setting and (c) H.P. consumption. This makes it possible easily and quickly for him to assure full productiveness of machine and operator at all times.

ADDED EQUIPMENT FOR ADDED PRODUCTION

1. Additional equipment in vast variety is available for the Series 62 line. Consider, by all means, the advantages of the "Air-Gage Tracer," a means by which thousands of users have reduced costs substantially.
2. Ask for descriptive booklet No. 1506 which not only describes the basic machine but the commonly used items of additional equipment. It includes full specifications.

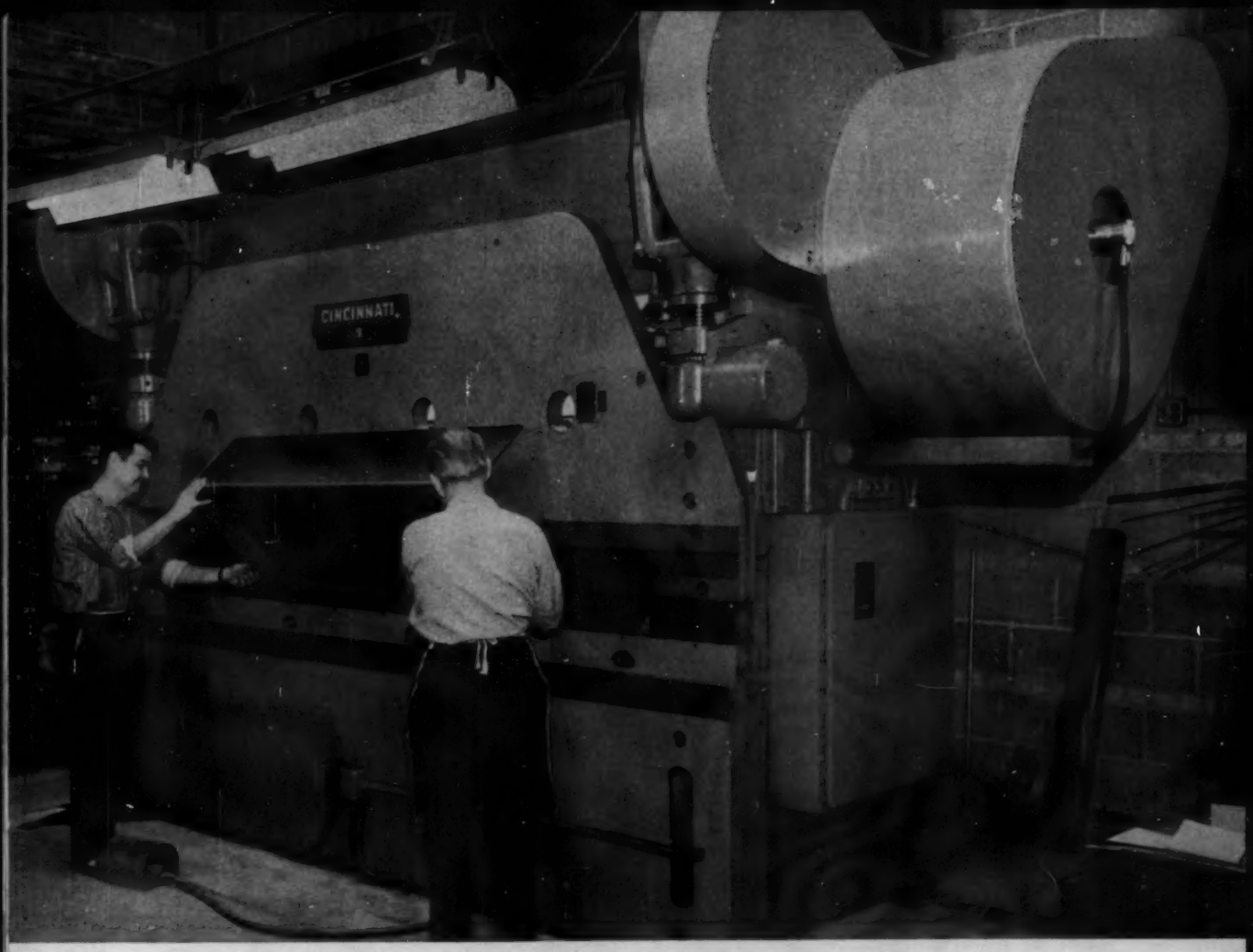
Monarch
TURNING MACHINES

CIRCLE 174 READER SERVICE CARD

CINCINNATI® PRESS BRAKE AND SHEAR

"cut our

"The Cincinnati equipment in our shop is the best in our operation," according to Sal Rochi of G. & M. Metal Fabricators, Franklin Park, Ill. Their Cincinnati Press Brake and Shear help make a wide variety



Courtesy G.&M. Metal Fabricators, Inc.

operating time"

of sheet metal products (radio chassis, boxes, cabinets, lighting fixtures, etc.).

"Our Cincinnati Press Brake with Automatic Cycle has cut our operating time in forming and perforating," says Rochi. (Automatic Cycle eliminates the need for clutch-slipping and jogging the ram.) "The Cincinnati Shear gives us sure accuracy for all our parts, from brackets to cabinets."

See our insert in Sweet's Machine Tool File.

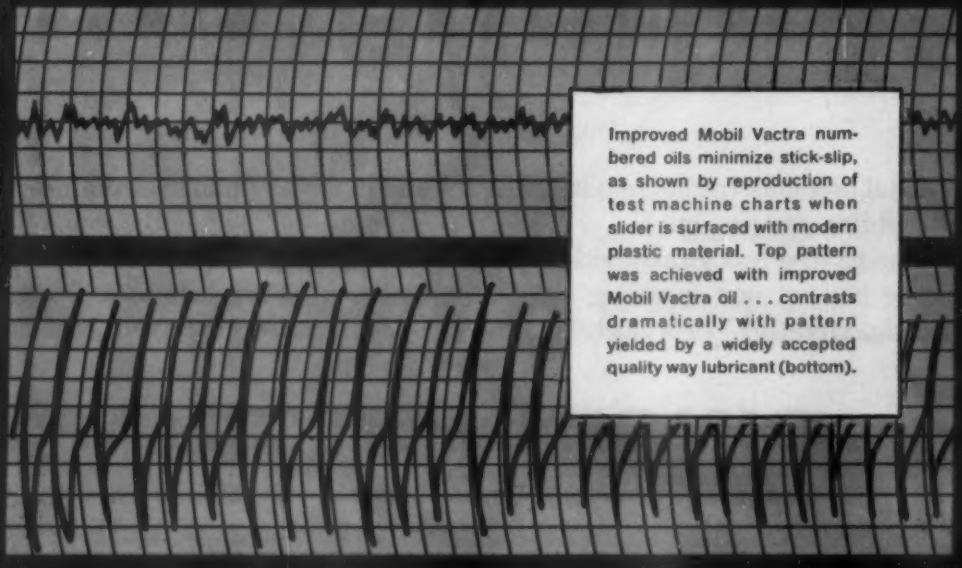
THE **CINCINNATI SHAPER** CO.

Shapers / Shears / Press Brakes Cincinnati 11, Ohio, U. S. A.

In Scotland: The Cincinnati Shaper Co., Ltd., Glasgow

NOW! WAY LUBRICANTS WITH ALL SIX

Stick-slip tester developed by Mobil's research laboratories closely simulates operating conditions of today's machine tools . . . records stick-slip electronically as weighted slider is pulled across lubricated cast iron bed.



Improved Mobil Vactra numbered oils minimize stick-slip, as shown by reproduction of test machine charts when slider is surfaced with modern plastic material. Top pattern was achieved with improved Mobil Vactra oil . . . contrasts dramatically with pattern yielded by a widely accepted quality way lubricant (bottom).

QUALITIES REQUIRED BY TODAY'S MACHINE TOOLS!

IMPROVED MOBIL VACTRA Nos. 1·2·3·4

Excellent for all way systems, all way surfaces, all operating conditions!

To meet the diverse requirements of today's complex machine tools, way lubricants must function effectively under a variety of operating conditions . . . must possess not one or two, but *six* important capabilities.

Now you can get all six—with Improved Mobil Vactra® oils Nos. 1-4, inclusive!

These improved Mobil Vactra oils provide these advantages: • Minimum stick-slip on all types of ways—steel, cast iron or plastic. • Control of table "float" through correct viscosity—without risk of film failure and wear. • Protection against way scoring through controlled EP qualities. • Prevention of lubricant filter clogging. • Protection against rust and corrosion. • Stability under all normal operating conditions.

Improved Mobil Vactra oils Nos. 1-4 offer these benefits:

- **Increased Machine Availability,** because less downtime is required for adjustments...especially significant with today's high overhead and burden rates.
- **Fewer Rejects,** through greater precision and better finishes . . . vitally important with today's closer tolerances and the high cost of finished pieces.
- **Minimum Maintenance Costs,** through effective protection of critical way surfaces.

Available in four viscosities, Improved Mobil Vactra numbered oils permit the selection of a grade exactly suited to any critical operating condition. For complete details, call your Mobil Representative or use the coupon below.

Mobil

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150 East 42nd Street
New York 17, N. Y.

Mobil Oil Company
Room 2057-A
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Gentlemen: I am interested in using Mobil Vactra Nos. 1-4 to help alleviate way lubrication problems at my plant.

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HALF ROUND

FILES

THE TWIST THAT'S TRUE!

ROLLING ACTION IS BUILT IN! Perfect smooth arcs come naturally with Heller Spiral Half Round Files. No need for rolling action. It's built in by Heller's Spiral Cut. Grooving is prevented.

20% MORE TEETH AT WORK! The exclusive spiral cut of Heller Half Round Files brings more teeth to bear on the surface than any other file of comparable size.

LASTS LONGER! Spiral Cut Half Round Heller Files — with exclusive indented over-cut — multiplies width of upcut teeth three times . . . makes files last longer.

ONLY HELLER HAS "WAVY" TEETH ON FLAT SIDE! A patented Heller design — combining coarse, medium and fine teeth — provides maximum cutting power . . . speeds work . . . smooths cutting.

TAKE THE GAMBLE OUT OF BUYING! Get the double assurance of Heller Files and your Heller Distributor's dependable service the next time you order. They are "sure bets" for complete satisfaction.

17-B-3

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America's Oldest File Manufacturer
NEWCOMERSTOWN, OHIO
Subsidiary of Simonds Saw and Steel Co.

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"Yes this was a modern shop in 1939——but..."

Why wait for new machine tools?

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Planning for the future is sound policy. But if you still have old-time machines that can't compete with the newer, more efficient equipment, then the future is already here!

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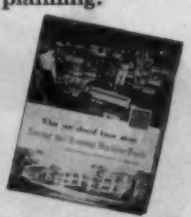
More and more forward-looking executives are turning to our leasing and extended payment plans as the best kind of future planning.

Ask for this important bulletin

"What You Should Know About Buying and Leasing Machine Tools" is an authoritative booklet which discusses the facts about depreciation, tax angles and details of this timely subject. Use the coupon to get your free copy.



GISHOLT MACHINE COMPANY

Madison 10, Wisconsin

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW-MACHINE GUARANTEE

Gisholt Machine Company
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Without obligation, please send your Bulletin 1173 with details regarding leasing and extended payment plans.

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New ARMSTRONG Swivel Pad can't come off

Now ARMSTRONG deep throat "C" Clamps have the new (Pat. apd. for) ARMSTRONG Ball-joint Swivel Pad. This "C" Clamp pad, developed by ARMSTRONG Engineers, is tougher than any on the market. Rigorous testing in our own plant first proved this fact, and field tests in factories throughout the country have confirmed our own test results.

Here's Why it's STRONGER . . .

The lip of the opening in the ARMSTRONG Ball-joint Swivel Pad is undercut so that when the ball of the screw is inserted, and the lip is permanently forced down, a solid steel wall is formed, inside the pad cavity, completely encircling the ball.

This wall of steel makes it impossible for the pad to come off the screw during normal use. In fact, our tests have proved that it is virtually impossible to intentionally knock the pad off with a hammer —yet the pad is free to swivel through an arc of approximately 40°.

Call your ARMSTRONG Distributor

Your ARMSTRONG Distributor can offer delivery from stock on this "400-Series" deep throat, drop-forged "C" Clamp with the new Ball-joint Swivel Pad. He also carries in stock the other styles of clamps in the ARMSTRONG Line—the broadest line of drop forged "C" Clamps.

ARMSTRONG BROS. TOOL CO., 5215 W. ARMSTRONG AVE. CHICAGO 46, ILLINOIS

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CIRCLE 182 READER SERVICE CARD ►

When you think of VERSATILITY

Lucas feeds the saddle ⇐

Lucas feeds the spindle ⇒

Feeds both in combination ⇒⇐

when necessary.

Combine these motions with

Vertical spindle head travel ⇕

and horizontal table travel ⇔

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if you need it.

The result . . . no machine tool can offer a greater combination of usable motions for boring, drilling, milling and related work.

Over twenty models and a dozen major attachments. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of versatility . . .

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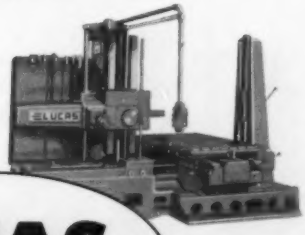

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When you think of FLEXIBILITY

Lucas provides

Lever control.

Pendant control

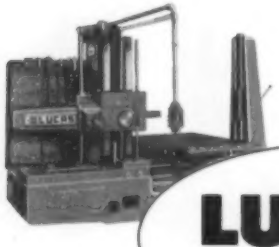
Tape control

and a variety of combinations of the three for flexibility of control suited to the type of work required.

For example . . . The Multiple Control Pendant selects speeds, feeds, unit travels, rapid traverse of head, table, saddle and spindle, plus the rotation of the spindle forward and reverse, jog and stop. Speeds and feeds can be pre-selected while the machine is in operation.

Practical applications of these controls are spelled out in a new catalog. Write Lucas Machine Division, The New Britain Machine Company, 12302 Kirby Avenue, Cleveland, Ohio. When you think of flexibility . . .

think of . . .



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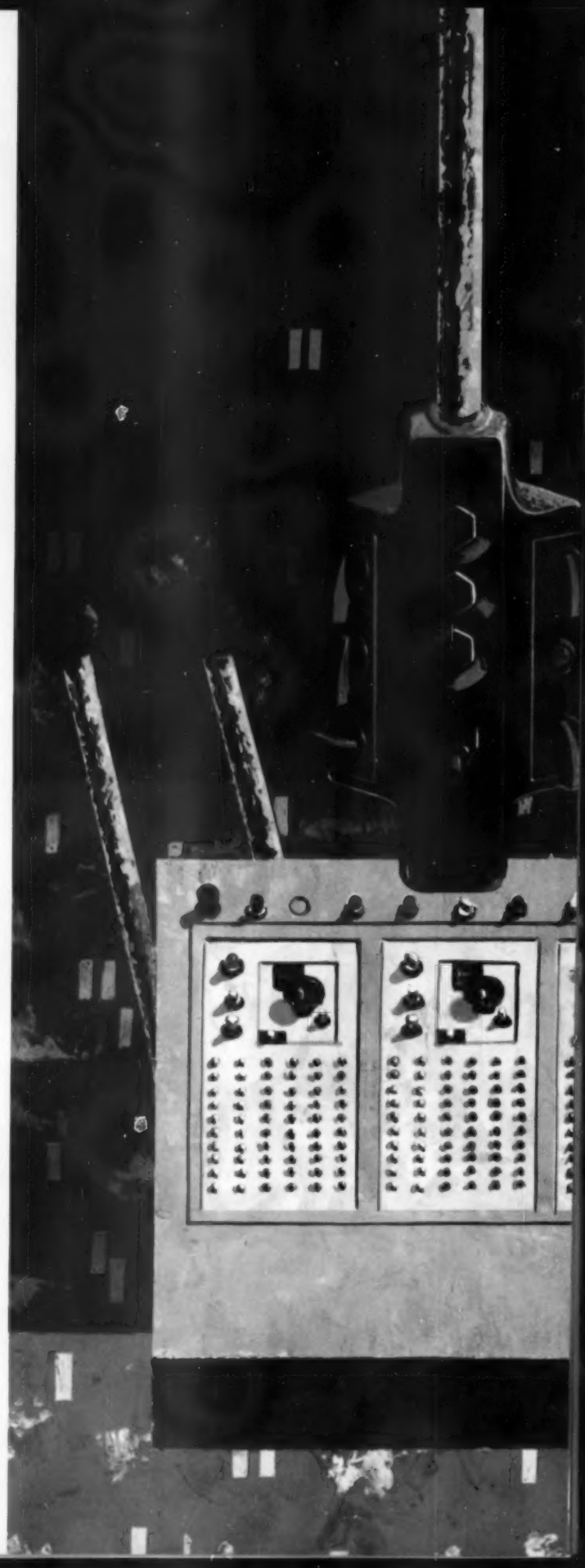

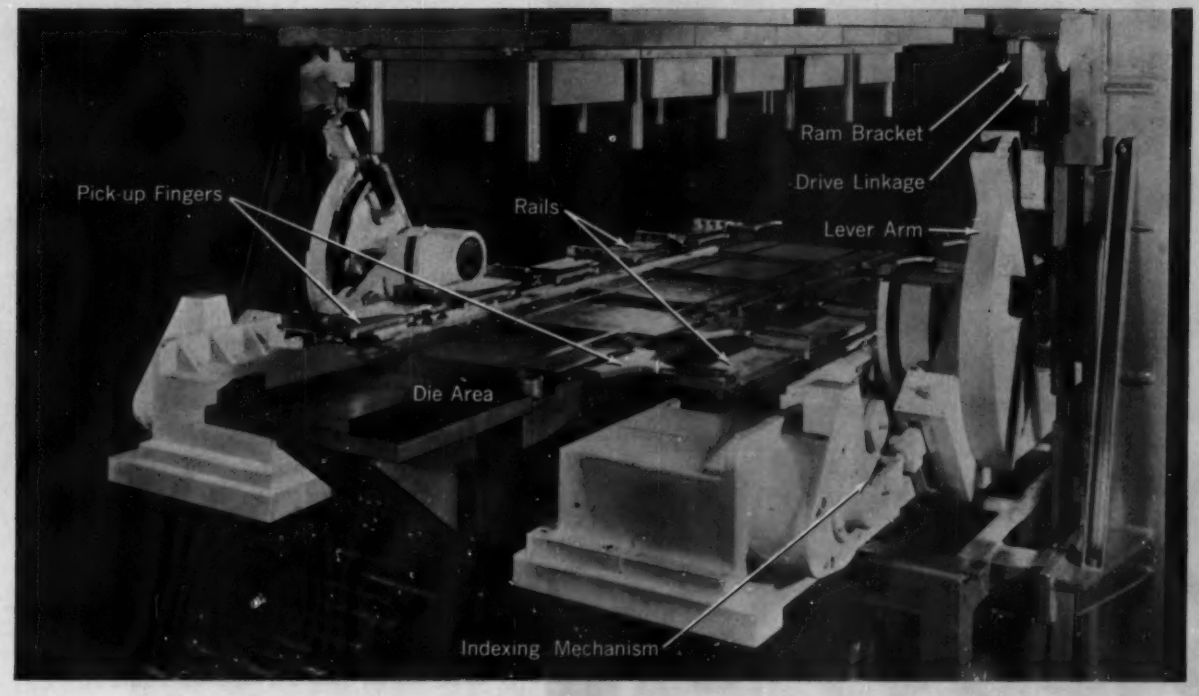

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Increase your production, improve the quality of your products and get your manufacturing costs down—with your present equipment.

This happy position is being enjoyed now by users of Sheffield PRESS-PACERS—demountable transfer devices which automate any straight side press or line of presses. Parts can be transferred from die to die in one press, or between presses in lines up to more than 125 feet long.

One press can be made to do the work of as many as five or six presses, reducing equipment and space requirements. The number of transfer operations is limited only by the capacity of the press or line of presses involved. Automatic handling from press to press prevents scrap generated by manual handling.

PRESS-PACERS are completely flexible. They have been tooled to handle interchangeably as many as seven parts. Model or engineering changes do not obsolete a PRESS-PACER—they only increase its value.

Blanks, pre-drawn parts, sheet and coil stock may be used, as desired. Feed fingers are interchangeable—feed distance is adjustable.

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You can see eight different PRESS-PACER installations right in your plant by means of a sound movie in color—and discuss your opportunity for savings with a factory engineer . . . write, wire or phone Contract Manufacturing Division.

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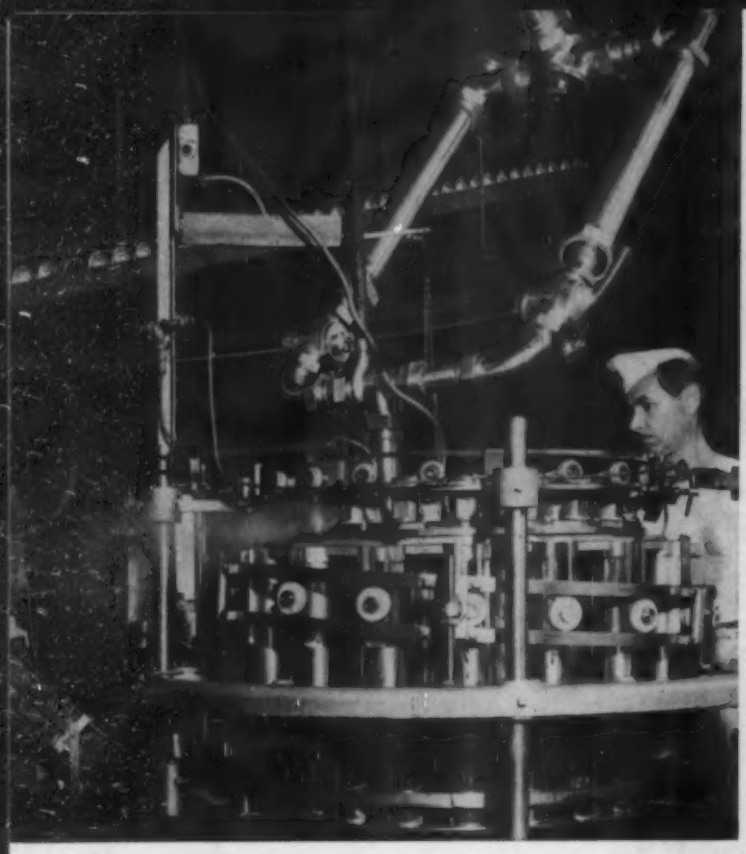


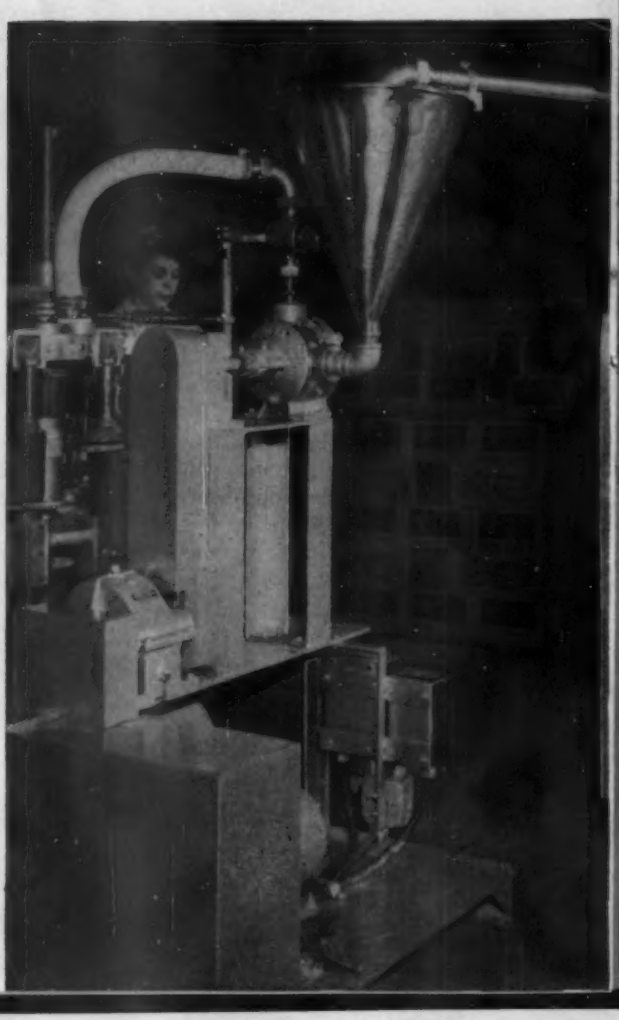
...LIQUID

If you make equipment that fills cans with chocolate or consomme, prune juice or pop, equipment made of Stainless Steel will do it fast, dependably, cleanly. The Votator* piston filler shown here happens to be filling cans with chocolate. Made of Stainless Steel, this filler can't harbor germs because Stainless Steel has a smooth, pocket-free surface. It is easily cleaned, too, so the strict standards of cleanliness that are mandatory in any food processing plant are easily maintained. Stainless Steel's resistance to corrosion makes it ideal for liquid applications.

VOTATOR is a registered trademark of the Chemetron Corporation.

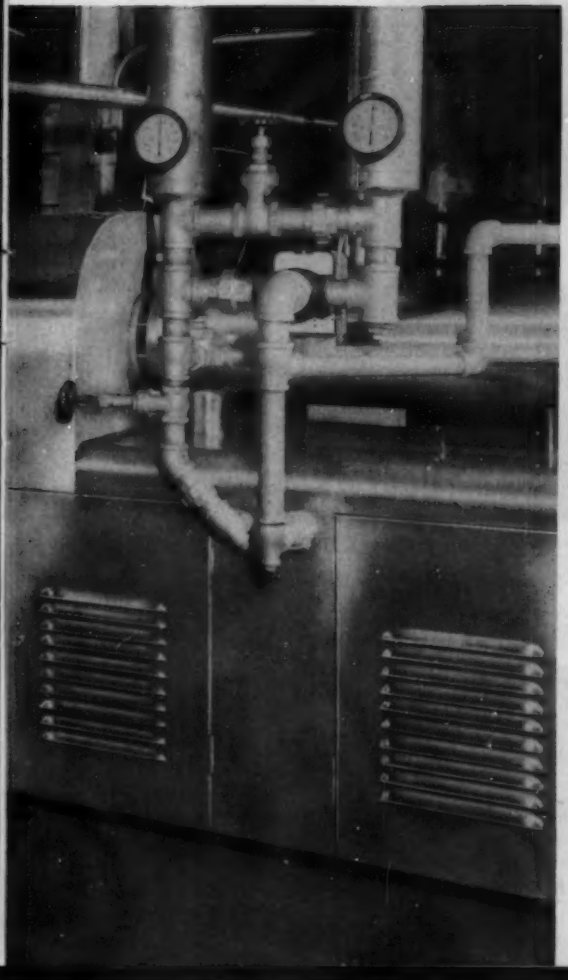
SOLID...

If you make equipment that processes solids like peanut butter or shortening, Stainless Steel can make your job easier and more profitable. This system makes peanut butter . . . and it makes it creamier. It takes whole peanuts in one end and grinds them, then Votator equipment heats them, cools them and turns out the finished product, ready for sandwich or cracker, at the other end. Here, Stainless Steel is used in the heads and shaft of the heat transfer area to assure maximum cleanliness. In a sealed unit like this one, corrosion could be a problem so Stainless Steel's inherent corrosion resistance is put to good advantage.



USS Stainless Steel . . . no other metal makes such a material difference in so many applications

This mark tells you a product is made of modern, dependable Steel.



...and in between

No material can match Stainless Steel's versatility. Stainless Steel offers designers and fabricators a unique combination of properties: superior strength, extraordinary corrosion resistance to an enormous variety of materials, outstanding properties at high temperatures, and attractive appearance. It is easily fabricated, and because Stainless Steel lasts longer, actually costs less in the long run.

For unmatched efficiency, durability, ultimate economy, specify Stainless Steels . . . no other metal makes such a material difference in so many applications.

If you have a selection or delivery problem, ask your USS representative or nearest Steel Service Center.

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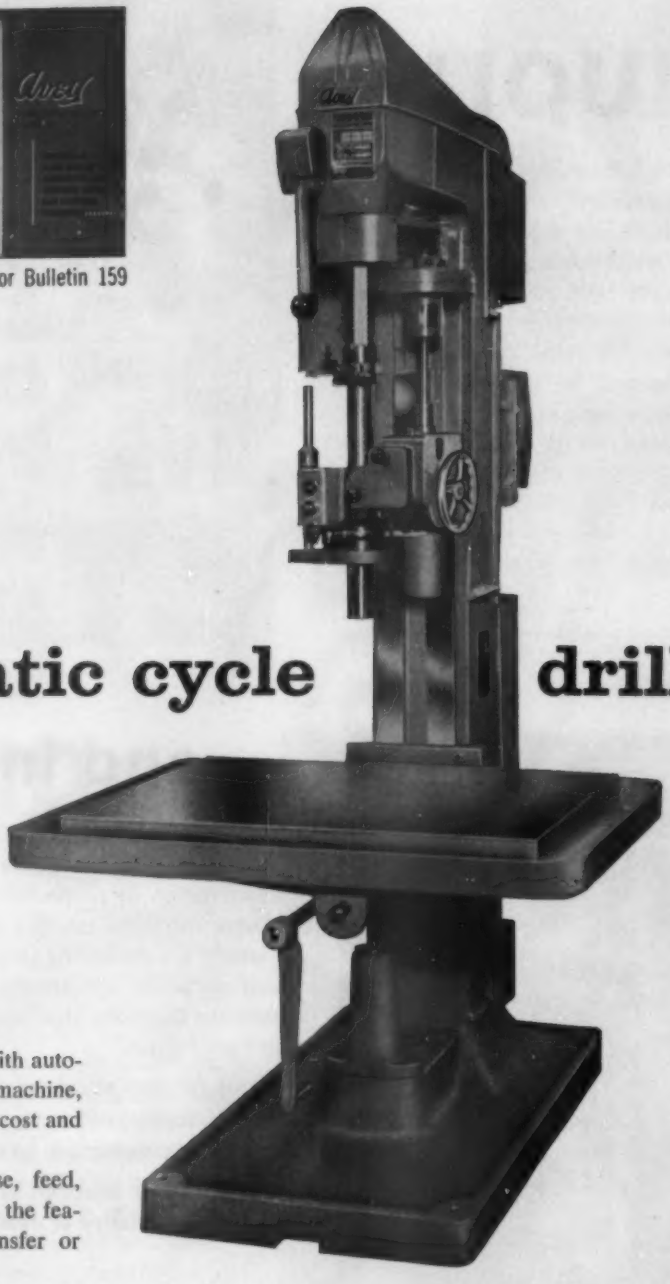

automatic cycle drilling

■ You can chop your time costs with automatic set-ups on this new Avey machine, and still take advantage of the low cost and flexibility of a standard unit.

Adjustable rapid power traverse, feed, and rapid return of the spindle are the features which permit automatic transfer or rotary index fixturing.

At the same time, you get adjustable feeds, speeds, table travel, head travel, and Avey's advanced spindle construction.

The machine is available with No. 2, 3, and 4 Morse Taper; 1 to 3 HP motors; single or multiple spindles. Your request for additional information will be promptly answered. Avey Division, The Motch & Merryweather Machinery Co., P. O. Box 1264, Cincinnati 1, Ohio.

Avey

Metallurgical Memo from General Electric

General Electric announces pre-honed CARBOLOY® inserts

Hand-honing is inaccurate, and time-consuming—frequently results in premature chipping and breaking.

Chamfered, or ground-flat, edges are geometrically weaker than a radius and are more easily chipped or broken.

Unhoned or as-ground inserts show rough edges—result in unpredictable tool life due to chipping.

Shown here, both under magnification and graphically, is an edge of the new Carboloy pre-honed insert. Radius is geometrically ideal to minimize chipping, extend tool life many times.

Now you get more predictable tool life... lower cost per cutting edge ...no hand-honing cost!

Ready-to-use... honed to a precise radius... promise BETTER PROFITS THROUGH BETTER TOOLING

Now General Electric Carboloy inserts are pre-honed *at the factory!* Here's what it means to you:

1. An insert with edges honed to precise *radii* gives the strongest geometric shape to withstand cutting pressures. This reduces chipping – increases the predictability of tool life. Hand honing *cannot* achieve precise radii – G-E pre-honing can . . . and does!
2. Since chipping is minimized, fewer cutting edges are wasted. The result is lower cost per cutting edge.
3. Since inserts come pre-honed and ready-to-use, the labor cost of hand honing is eliminated. This more than offsets the charge for pre-honing.
4. Pre-honed Carboloy cemented carbide inserts have standard edge radii honed to a greater or lesser degree, depending on the job to be done. You'll *know* the honing is right!

Ask your Authorized Carboloy Distributor about pre-honed Carboloy inserts, convertible seats, toolholders, and brazed tools. Or, write: *Metallurgical Products Department of General Electric Company, 11149 E. 8 Mile Street, Detroit 32, Michigan.*

TOPS IN TOOLING QUALITY

From the research and quality-control facilities of the Metallurgical Products Department of General Electric comes the outstanding quality tooling line in the metalworking industry. The new Carboloy pre-honed inserts, as well as the complete line of Carboloy toolholders, inserts, insert seats, convertible seats, and brazed tooling, are designed to meet every tooling need efficiently and economically.

CARBOLOY®
CEMENTED CARBIDES

METALLURGICAL PRODUCTS DEPARTMENT

GENERAL ELECTRIC

CARBOLOY® CEMENTED CARBIDES
MAN-MADE DIAMONDS • MAGNETIC MATERIALS
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(Advertisement)

Cold heading is a high-speed, high-volume process even with intricate parts requiring secondary operations. Die sets are not expensive—set-up time is moderate. Scrap is no factor. Cold working improves mechanical properties. Use the handy chart and comparative data covering 14 suitable Anaconda alloys to open the door to some sizable savings. Take a second look at the way you're making parts like those at the right—and connector components in electrical controls—and bases for semiconductor devices.

Fast, low-cost cold heading with these Anaconda

Alloys and Nominal Compositions, %	Temper*	Prop. Limit, 1000 psi	Yield Str., 0.2% Offset, 1000 psi	Tensile Strength, 1000 psi	Red. Area, %	Plasticity Index, %
Brasses						
Commercial Bronze-14 90 Cu, 10 Zn	A	20.5	43.0	51.0	85	40
	B	39.0	57.5	64.0	81	61
Red Brass-24 85 Cu, 15 Zn	A	23.0	49.5	55.0	82	42
	B	42.0	62.0	71.0	77	59
Low Brass-32 80 Cu, 20 Zn	A	33.5	50.0	57.0	81	59
	B	44.0	65.0	76.5	79	58
Cartridge Brass-42 70 Cu, 30 Zn	A	32.5	51.0	63.5	80	51
	B	48.0	70.0	82.5	73	58
Yellow Brass-58 65 Cu, 35 Zn	A	38.0	52.0	62.0	79	61
	B	52.5	70.5	81.0	72	65
Cupro Nickels						
Cupro Nickel, 10%-755 88.35 Cu, 10 Ni, 1.25 Fe, 0.4 Mn	A	38.5	52.0	54.0	81	71
	B	56.5	76.5	79.0	80	72
Cupro Nickel, 20%-712 79.5 Cu, 20 Ni, 0.5 Mn	A	34.5	57.5	60.5	83	57
	B	46.0	69.5	74.0	74	62
Nickel Silvers						
Nickel Silver, 18%-716 72 Cu, 9.75 Zn, 18 Ni, 0.25 Mn	A	37.5	57.5	60.0	83	63
	B	39.5	64.5	67.5	78	59
Nickel Silver, 12%-744 65 Cu, 22.75 Zn, 12 Ni, 0.25 Mn	A	43.0	58.0	67.0	77	64
	B	50.5	81.0	86.0	73	59
Tin Bronzes						
Phosphor Bronze, (A)-351 94.75 Cu, 5 Sn, 0.25 P	A	38.0	60.5	66.0	83	58
	B	50.0	80.0	87.5	79	57
Phosphor Bronze, (C)-353 91.75 Cu, 8 Sn, 0.25 P	A	44.0	64.0	76.5	81	58
	B	57.0	90.0	99.0	76	58
Phosphor Bronze, (D)-354 89.75 Cu, 10 Sn, 0.25 P	A	49.5	73.5	86.0	71	58
	B	66.5	101.0	111.0	69	60
Leaded Copper-126						
99 Cu, 1 Pb	A	20.0	40.0	41.5	69	48
	B	27.5	48.0	51.5	64	53
Copper-Silicon Alloy						
Everdur® -1015 98.25 Cu, 1.5 Si, 0.25 Mn	A	34.5	54.0	55.5	81	63
	B	43.5	67.0	74.0	76	59

*The temper designations "A" and "B" have no commercial significance.

This table includes results of special tension tests made in Anaconda laboratories. It is a useful guide to the right copper alloy for a cold heading job.

Each alloy is shown in two standard tempers, A (¼ hard) and B (½ hard). These designations show the amount of mechanical strengthening the alloy has been subjected to before cold heading. Though it is assumed that the cold heading process enhances these values, the preheading values are widely used in design—to be on the conservative side. The tempers obtained by wire drawing represent the following cold reductions: A, about 20%; B, just under 40%.

"Plasticity Index" is a useful indicator of the amount of cold work an alloy will take. It is the ratio of proportional limit to ultimate tensile strength expressed in per cent. A low value of the index indicates that a large part of the total stress range to fracture is devoted to deforming the alloy plastically. Thus an alloy with a low value flows more easily during the cold heading, and parts made from it can be designed with greater complexity of shape. For best formability, a low plasticity index should be coupled with a high percentage reduction in area—to minimize shear fracture.

The effect of alloying elements on mechanical properties is clearly seen in the table. The main purpose of alloying copper is to increase ultimate and yield strengths. Alloying has other important effects, but the table shows how these alloying elements influence the balance between increased strength and formability in cold heading. In the selection of an alloy for cold heading, this interplay is usually the major consideration—with factors like corrosion resistance, color, surface finish, and cost playing supplementary roles.

WHAT ALLOYING ELEMENTS DO—Addition of a second element, or a series of elements, to copper affects the crystal structure so that flow in certain directions becomes difficult except by going to higher stress levels. The effect depends not only on the element added but on its proportion in the matrix. Here are brief descriptions of how the various major alloying elements influence the engineering behavior of copper metal:

ZINC plus copper makes brass up to 20%, the "low brasses"; from 20% to about 35%, the "high brasses." The addition of zinc substantially improves strength, yet the metal retains good formability (a low plasticity index with high reduction in area). Malleability does, however, decrease as the percentage of zinc increases. The diagram on the next page illustrates how a choice is made between alloys of similar zinc content. Thermal and electrical conductivity decrease as zinc content increases, and color changes from reddish hue to greenish yellow.

NICKEL, the principal alloying element in the cupro nickels, improves resistance to corrosion. In the nickel silvers, nickel and zinc also control color. As nickel content increases, color moves from brass shades to silver white. Both cupro nickels and nickel silvers have high percentage reduction in area. Their slightly higher plasticity index tends to reserve their use to parts requiring exceptional corrosion resistance.

TIN as the main alloying element in the phosphor bronzes contributes high tensile and yield strengths, along with excellent fatigue resistance. For cold heading, the biggest advantage of phosphor bronzes is their favorable combination of low plasticity index and

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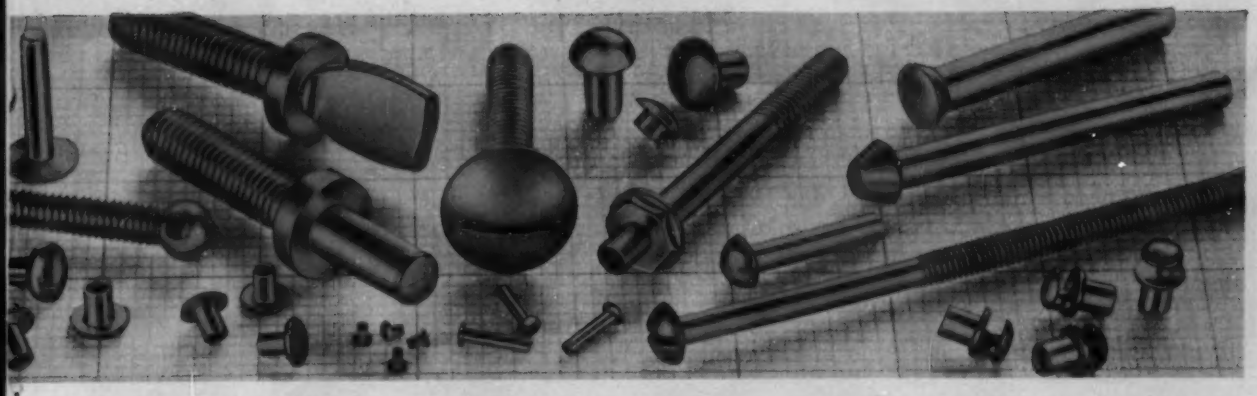


alloys can solve more problems than you realize

high reduction in area—second only to the straight brasses. Electrical and thermal conductivities drop as tin content increases.

LEAD enhances the machinability of copper by acting as an embrittling agent, correspondingly reducing the per cent reduction in area, but with little effect on the plasticity index. For cold heading, this means that even though the plastic range is great, there is a limiting amount of work hardening that can be reconciled with shear strength. Though it is not recommended for shapes where shear forces predominate in the cold heading operation, Leaded Copper-126 has some very interesting advantages. It has an electrical conductivity rating of 98% IACS and a machinability rating of 80 (free-cutting brass = 100) for economical secondary operations. It offers a possible means of reducing the cost of electrical connector components, where shape and tolerances are within the range of cold heading capabilities.

SILICON content of 1.5% adds toughness to copper and improves its ductility — providing a combination of plasticity index and reduction in area favorable to cold heading. Such an alloy is well-suited to impact applications, particularly where very low temperatures are met, as in cryogenic equipment. As the lower copper-silicon alloys work-harden less rapidly than those of higher silicon content, Everdur-1015 (shown in the table) was developed for cold headed parts, especially where secondary operations, like roll-forming of threads, are required.

UPSET RATIO IS IMPORTANT — The alloys and alloy groups shown in the table are all suitable for cold heading. Often, however, the precise strength level or the exact service conditions are not known. Then the best guide is the approximate amount of cold work needed to form a given upset. This is the upset ratio—the ratio of final upset diameter to the original wire diameter.

WHEN UPSET RATIO IS FROM 2 TO 3, only one or two blows are usually necessary, and the choice of material is not critical. Any alloy from the table, in any temper, will be suitable.

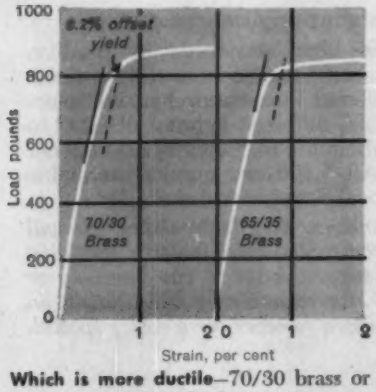
WHEN UPSET RATIO APPROACHES 4.5 TO 5, two or more blows are necessary, and selection of material becomes critical. Choice is usually made after trial heading of one or more possible combinations of alloy and temper.

FOR UPSET RATIO OVER 5, multiblow or progressive heading must be employed, and annealing between blows may be necessary. Here only alloys with the most favorable combination of plasticity index and per cent reduction in area should be considered.

SEMICONDUCTOR BASES. As quantities of these components soar, cold heading should be considered for economical production. Many of the copper alloys offer the high electrical and thermal conductivities needed. But severe heat cycling in manufacture rules out the cold heading alloys listed. The metal must be deoxidized or oxygen-free to resist hydrogen embrittlement. For secondary operations, it must also have good machinability. And where high torque is used to tighten the base to the heat sink, it must in addition have high strength. Various combinations of these properties are found in such alloys as DLP Copper-104, OFHC* Copper-120, Tellurium Copper-127, and Chromium Copper-999 — all available as cold heading wire.

TECHNICAL SERVICE. Although Anaconda American Brass does not produce cold headed parts, it does make cold heading wire in the wide variety of alloys and tempers required. Anaconda has specialists in this field to help you select the right material for your job. Simply give us a sample, sketch, or description of the part or parts—along with service conditions, quantities, properties required — for a recommendation. See your Anaconda representative, or write: Anaconda American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

*Trademark American Metal Climax Inc.



Which is more ductile—70/30 brass or 65/35 brass? These load-strain curves on the two alloys in temper A (¼ hard, 18% reduction) shows 70/30 cartridge brass is slightly more formable—because it begins to flow plastically sooner than the 65/35, yet continues to deform to a higher ultimate load. Thus the plasticity index is lower. This, combined with higher per cent reduction in area, makes 70/30 a better choice when shear is a major factor.

ANACONDA®

COPPER AND COPPER ALLOY COLD HEADING WIRE

Anaconda American Brass Company

IT PAYS TO STANDARDIZE ON STANSCREW

Stanscrew fasteners add to reliability of SPEED QUEEN appliances

Speed Queen laundry appliances are built to take a beating. In these automatic washers and dryers, components are necessarily subjected to vibration, heat, moisture, and customer abuse . . . must withstand punishment year after year if Speed Queen's outstanding reputation for quality is to be upheld.

For example, consider the socket set screw being inserted on the motor pulley above. Should this loosen, the customer would have to pay for a service call . . . and Speed Queen would have to pay in consumer dissatisfaction. Therefore, to maintain rigid quality standards, Speed Queen has chosen Stanscrew fasteners for this and other demanding applications.

Despite their high standards of quality, Stanscrew fasteners are economically priced. And they are offered in a comprehensive selection of over 5,500 different types and sizes to meet the overwhelming majority of all fastener requirements. All 5,500 are quickly available through your local Stanscrew distributor.

Call your Stanscrew distributor today. He will arrange a visit from a Stanscrew fastener specialist who can often suggest ways to cut assembly or fastener costs . . . for example by substituting an inexpensive standard fastener for a costly special.

STANSCREW FASTENERS

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HMS | HARTFORD MACHINE SCREW COMPANY, HARTFORD, CONNECTICUT
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When you inspect the new AMERICAN Positioning Table, you'll find a brand new concept in numerical control!

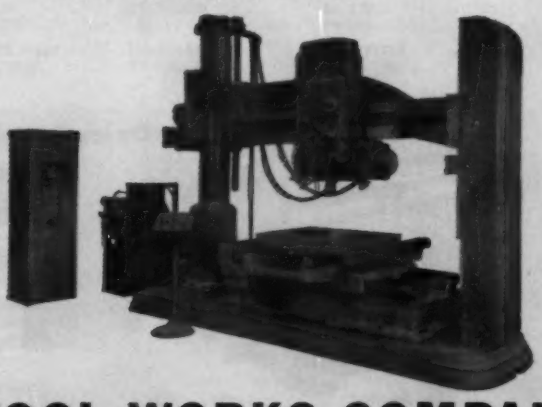
No steel fingers feel and wear the Mylar tape. Entire blocks of information are read at once . . . *by low pressure air* . . . instantly positioning and holding the table without mechanical clamps.

In addition to extremely fast and error proof positioning, the American Positioning Table gives you accuracy of ±.00025" and repeatability of ±.00005" without fail!

Designed by The American Tool Works Company in conjunction with Sperry-Gyroscope electronic engineers, your American ultra-precision Positioning Table is simple to operate and entirely safe from human error.

Ask your American Distributor about "Toolease", our leasing plan under which an American Positioning Table and American Hole Wizard Radial Drill can improve your production . . . while it pays for itself! Or write Section 162 at the address below.

Ask for Bulletins 700 and 801.



THE AMERICAN TOOL WORKS COMPANY

PEARL STREET AT EGGLESTON AVENUE • CINCINNATI 2, OHIO

CIRCLE 192 READER SERVICE CARD

You get these benefits...

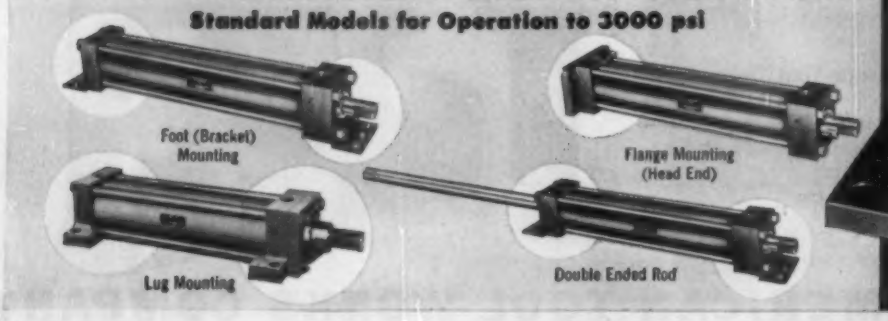
- ✻ **prompt delivery**
- ✻ **competitive pricing**
- ✻ **any external mounting to meet your requirements**

When you BUY

VICKERS HYDRAULIC CYLINDERS

Typical of custom designs that can be furnished readily from Vickers new cylinder facility is this model built with extra rigidity and strength at both rod and clevis ends to overcome side loadings. For added corrosion resistance, stainless steel clevis pins, piston rods, retaining screws and grease fittings are used.

Standard Models for Operation to 3000 psi



Choose the cylinder "outside" that's best for your installation—Vickers offers you a wide selection of standard mountings plus an almost unlimited range of special configurations. Alternate rod end threads . . . straight thread port connections . . . extra barrel lengths for bearing support . . . are among many available options.

- Working pressures to 3000 psi (non-shock)
- Hard chrome plated, ground and polished, high-strength alloy steel piston rods.
- Large ports hold pressure drop within desirable limits.
- Fast, accurate parts replacement is assured because all cylinders are individually registered.
- Honed barrels of heavy walled seamless tubing minimize friction and wear.
- Cushions can be provided—either head, rod or both ends.
- Your choice of automotive step-cut piston rings for maximum life or low friction "T" rings for applications requiring minimum leakage. Full size cast iron piston for maximum bearing support with either type seal.
- Synthetic rubber wiper ring is standard--metallic wipers available.
- Two large wrench flats on rod are standard—additional flats available on request.
- Fully meet JIC specifications.

New, separate plant facilities—devoted exclusively to the design and manufacture of hydraulic cylinders—assure prompt individual attention to your orders. Service stocks are maintained at all Vickers warehouses in the U.S. and Canada. For more application data and installation dimensions, call or write today for Bulletin 60-68

VICKERS INCORPORATED

DIVISION OF SPERRY RAND CORPORATION

Machinery Hydraulics Division

ADMINISTRATIVE and ENGINEERING CENTER

Department 1410 • Detroit 32, Michigan

FOR PROMPT SERVICE CALL:

DETROIT TOwnsend 8-0272	**CINCINNATI** MAin 1-1756	**INDIANAPOLIS** CLifford 3-3535	**PHILADELPHIA (Area)** LOwell 6-7900	**SAN FRANCISCO (Area)** ATlantic 4-7106
ATLANTA TRinity 4-0187 2-0837	**CLEVELAND** EVergreen 2-3366	**LOS ANGELES (Area)** ORegon 8-2503	**PITTSBURGH (Area)** LOcust 1-3504	**SEATTLE** MUtual 2-6950
BIRMINGHAM TReemont 1-9531	**GRAND RAPIDS** GLendale 6-1146	**MILWAUKEE** UPtown 1-0860	**ROCHESTER** LOcust 2-5384	**ST. LOUIS** PArkview 1-4311
CHICAGO (Area) POrter 6-2900	**HOUSTON** JAckson 2-9623	**NEW YORK (Area)** DRexel 6-3500	**ROCKFORD** WOodland 2-0615	**WORCESTER** SWift 8-3706

8903

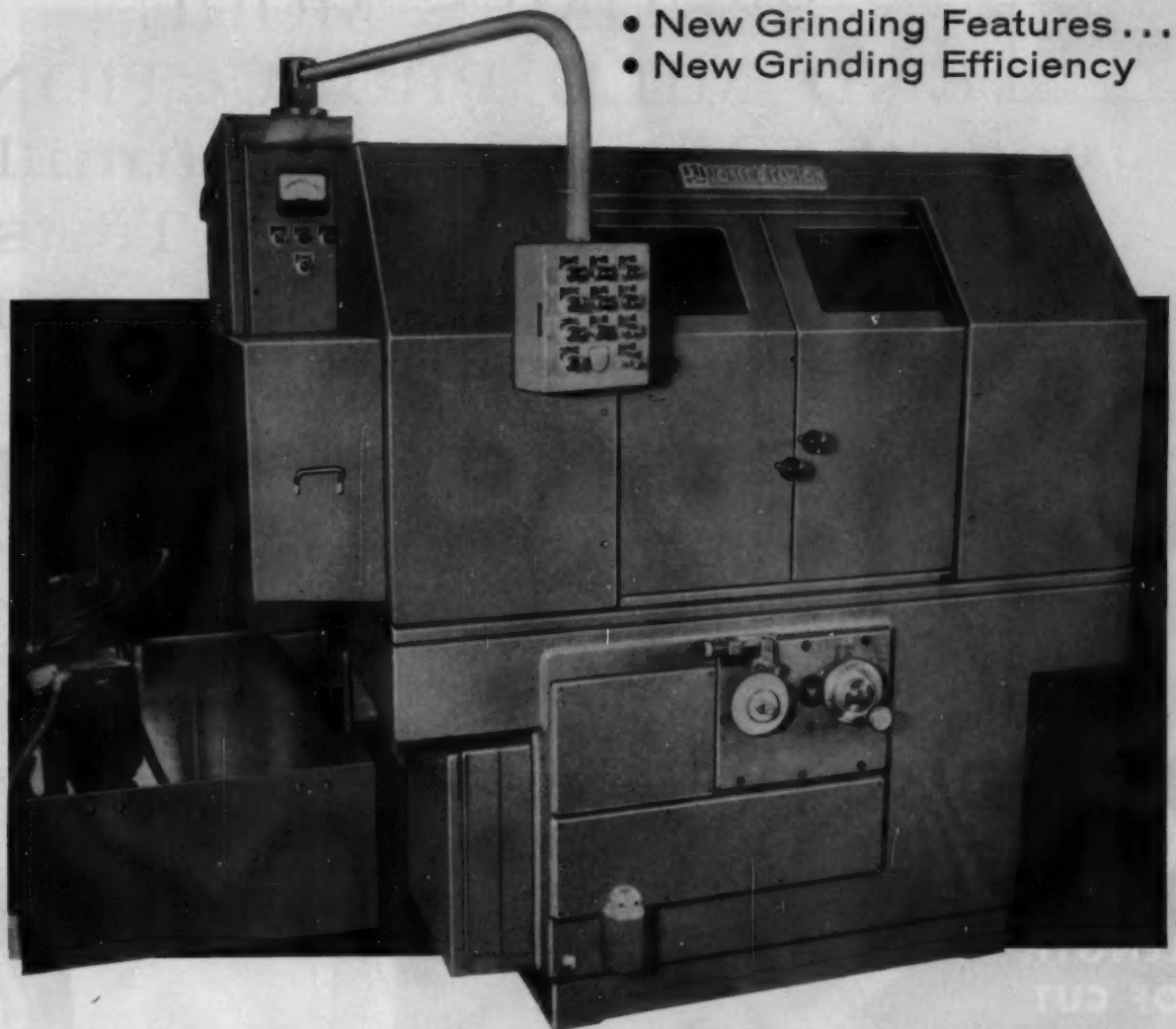
Standard Models for Operation to 3000 psi

the complete line For Butterfield end mills, delivery time is short, service life is long. That's true of all other Butterfield tools: drills, reamers, taps, dies, counterbores, cutters, hobs and carbide tools. Phone for these, or for technical aid. Warehouses in Chicago, Detroit, Fort Worth, Los Angeles, New York and San Francisco. **Call your Butterfield Distributor.**

BUTTERFIELD

DIVISION, Union Twist Drill Company, Derby Line, Vt.

• New Grinding Features . . .
• New Grinding Efficiency



The J&L Model E-2 Automatic Form Grinder

with PERPETUAL FORM CONTROL through a full 12" width!

J & L's new Model E-2 Automatic Form Grinder offers a combination of features that add up to unprecedented production efficiency.

Wide range of work speeds, from 50 to 1500 R. P. M. New unitized headstock has a constant-speed AC motor, with fast cycling achieved by means of an electric clutch and brake. Proper surface speeds available for all diameters up to 8".

Completely automatic cycle, with automatic positive size control. High-speed approach, variable feed, spark-out and withdrawal are positively controlled through simple cam action. Wheel slide is held against a positive stop with uniform hydraulic pressure.

All kinds of wheel trueing, including PFC through 12" width. All types of J & L diamond dressers are available. Also, crush dressing for wheels up to 4" in width. In cemented diamond particle cutters for continuous wheel forming, there are sensational new capacities up to 12" wide.

Capacities up to 31", for precision shaft work. Swivel-type platen up to 15°. Up to 31" between centers. Equally suitable for chuck work.

For detailed information, write today for Form 5916.

JONES & LAMSON

MACHINE TOOL DIVISION

Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont

FOR THAT EXTRA EDGE IN PRODUCTION!

3½ TIMES MORE END MILL PRODUCTION with the New B&S Thriftmill® in Competitive Shop Tests!

20% Lower Initial Cost, Superior Microfinish and Less Downtime also Proved using new B&S Thriftmill.®

TEST DATA

MATERIAL:

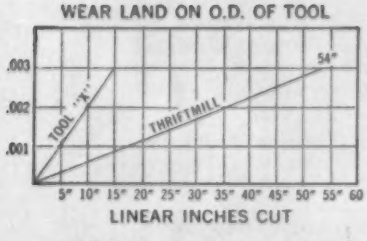
MATERIAL: A1S1-D3 oil hardening tool steel. Hardness, Rockwell C-18.

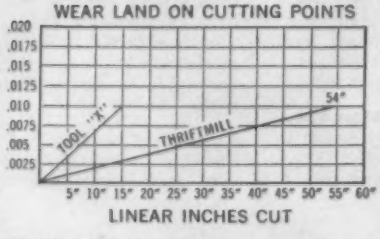
BOTH END MILLS

½" Dia., 4 flute.

CUTTING DATA

	RPM	SFM	CHIP LOAD	TABLE FEED	DEPTH CUT	WIDTH CUT	LENGTH CUT
B&S Thriftmill®	325	43	.00125	1⅝"	¼"	½"	54"
BRAND "X" End Mill	325	43	.00125	1⅝"	¼"	½"	15"





MICROFINISH AFTER TESTS

B&S Thriftmill, bottom of slots, RMS 35.

B&S Thriftmill, sides of slots, RMS 30-38.

BRAND "X" End Mill, bottom of slots, RMS 70-100.

BRAND "X" End Mill, sides of slots, RMS 40-60.

The initial economy of the new B&S Thriftmill, together with the proven production benefits engineered into this fine tool, gives a competitive advantage to all B&S Thriftmill users. Now available in 2 flute, 4 flute, single and double end.

There are 1065 different "standard" off-the-shelf B&S end mills to choose from. End wonder, worry and wait—take advantage of B&S tooling superiority and speedy service—call your B&S Distributor now.

Send for "Condensalog" to: Cutting Tool Division, Brown & Sharpe Mfg., Co., Providence 1, R. I.

Brown & Sharpe HIGH SPEED STEEL CUTTING TOOLS

NELCO CARBIDE CUTTING TOOLS

AT LAST! THE FIRST COOLANT THAT POSITIVELY ELIMINATES RANCIDITY AND RUST

...while preventing Dermatitis better than any coolant ever marketed

TWIN KOOL

with HEXACHLOROPHENE (U.S. Reg. T. M., Sindar Corp., U.S. Patent 2,535,077)

MACHINING OPERATIONS: TWIN-KOOL's neat removing quality and extraordinary lubricity afford faster production and longer tool life.

GRINDING OPERATIONS: TWIN-KOOL's remarkable cooling and wetting-out qualities enable you to operate without wheel loading.

Agents' Inquiries Invited

Modern chemistry has scored an advance of extreme interest to a cost-conscious metal-working industry. New TWIN-KOOL, with Hexachlorophene, the miracle additive, not only gives you a cooling performance unequaled by any other present formula, but prevents rancidity, Dermatitis and rust, the three most common deterrents to proper coolant performance. When mixed with water, TWIN-KOOL produces a brilliant, clear red, true solution, not an emulsion. Your operators see their work clearly at all times. Thoroughly field-tested and proven over the past two years, TWIN-KOOL is now available for immediate shipment in quantity. Order today in 55 gal. drums, or take advantage of the free offer. Test TWIN-KOOL in your own machines now.

FREE! USE THE COUPON BELOW FOR A FREE TEST SAMPLE!

(Enough TWIN-KOOL to make up to 40 gal. of grinding solution or up to 15 gal. of cutting solution.)

TWIN SPECIALTY OIL CO.
P.O. Box 158 • Merion Station, Pa.

Gentlemen:

Please forward your free test sample of TWIN-KOOL with Hexachlorophene to my attention. I am interested in using it for ☐ GRINDING ☐ MACHINING ☐ BOTH

NAME_____ POSITION_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____

FILL-IN AND MAIL COUPON TODAY!

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Gage Blocks of CARMET Chromium Carbide

for new standards of dimensional control!

For enduring, ultra micro-accurate surface finishes and dimensional stability, CARMET Chromium Carbide represents the ultimate gage block material.

Harder by nature than steel . . . next to a diamond in hardness, yet far tougher . . . Chromium Carbide Gage Blocks withstand rougher use, eliminate costly dimensional errors, and cut frequency of calibration and replacement. They have a thermal coefficient of expansion similar to steel. Fingerprints are not harmful.

Lightweight, non-oxidizing, possessing superior "wringability" and a stable, fine grain structure that takes and holds a mirror-smooth gaging surface . . . CARMET Chromium Carbide in gage blocks is leading the way to rigid new standards of dimensional control.

Carmet doesn't make gage blocks, but furnishes the chrome carbide to the progressive manufacturers who do.

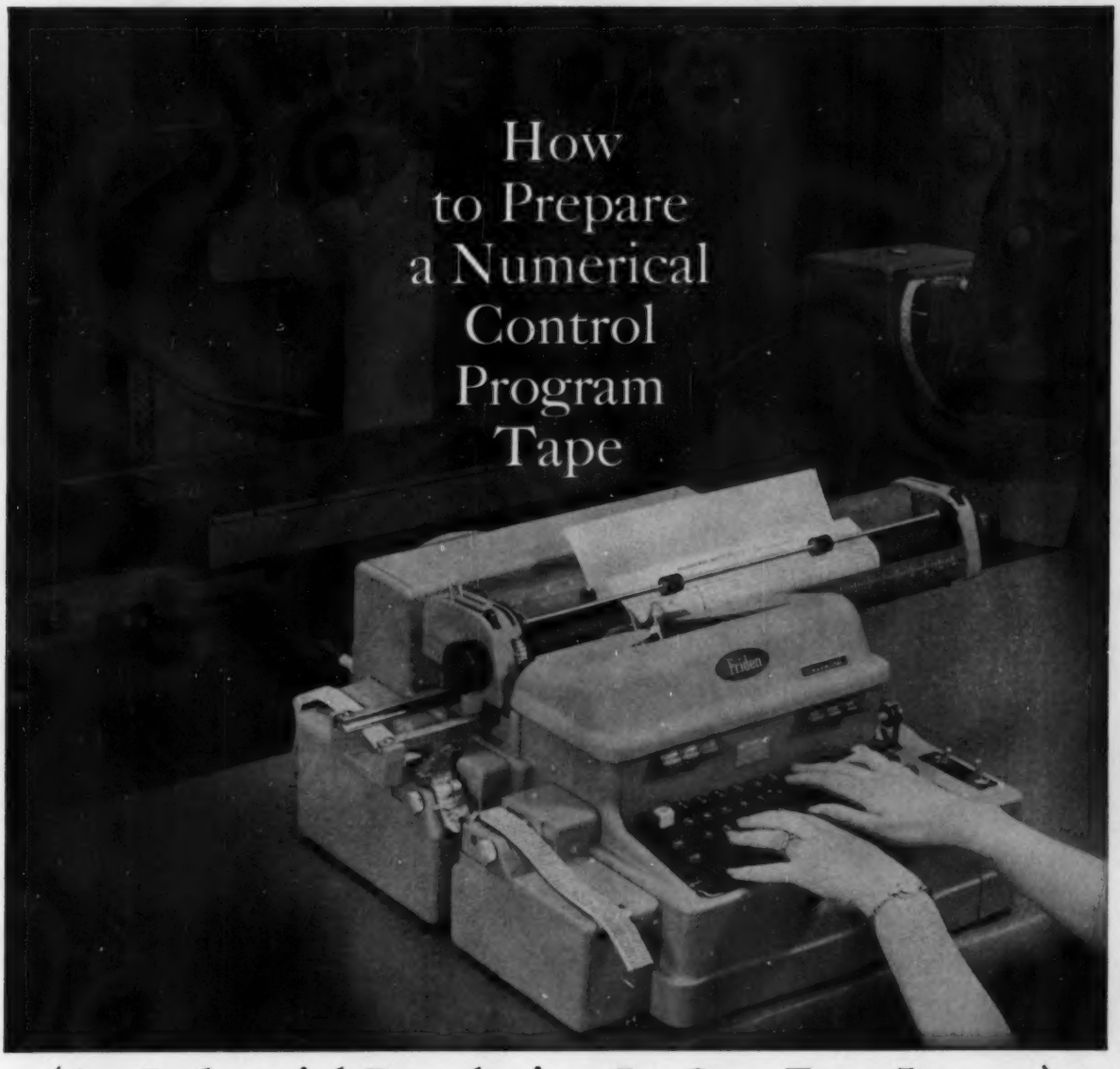
A precise blend of extremely hard, finely divided carbides of chromium with a nickel binder, CARMET Chromium Carbide assures predictable, consistent behavior and unmatched uniformity from piece to piece.

These same unique characteristics make CARMET Chromium Carbide an important material for extrusion dies, valve seats, sealing rings, chemical processing equipment . . . or any other application where resistance to oxidation, corrosion, abrasion, erosion or chemical attack may be involved. For more information, contact your local Allegheny Ludlum CARMET representative, or write: ***Allegheny Ludlum Steel Corporation, Carmet Division, Ferndale, Detroit 20, Michigan.*** *AM10-1*

1788

CARMET® AL

CEMENTED CARBIDE • DIVISION OF ALLEGHENY LUDLUM



(An Industrial Revolution In One Easy Lesson)

This is the Friden Flexowriter: a heavy-duty, automatic electric typewriter, with an integral tape punch and tape reader. There is no faster, easier or better device for coding paper tapes. Here's why:

1) The keyboard is standard; any competent typist can master the other controls in less than an hour.
2) The operator types a visual proof as she makes the tape; errors are caught and corrected immediately.
3) Automatic parity check guarantees against mis-coding.
4) Tapes can be double-checked (or quickly duplicated) by running them through the reader.

For all these reasons, the great majority of machine tool manufacturers either *have standardized* or *are now standardizing* on the Friden tape reader with Flexowriter input. Take it from the pioneers in numerical control: punched paper tape is the best input; and in punched paper tape, Friden is by far the leader.

In business, communications, graphic arts, and now in heavy industry, Friden source data systems build a new concept. We call it PRACTIMATION: automation so hand-in-hand with practicality there can be no other word for it. ©1960 FRIDEN, INC.

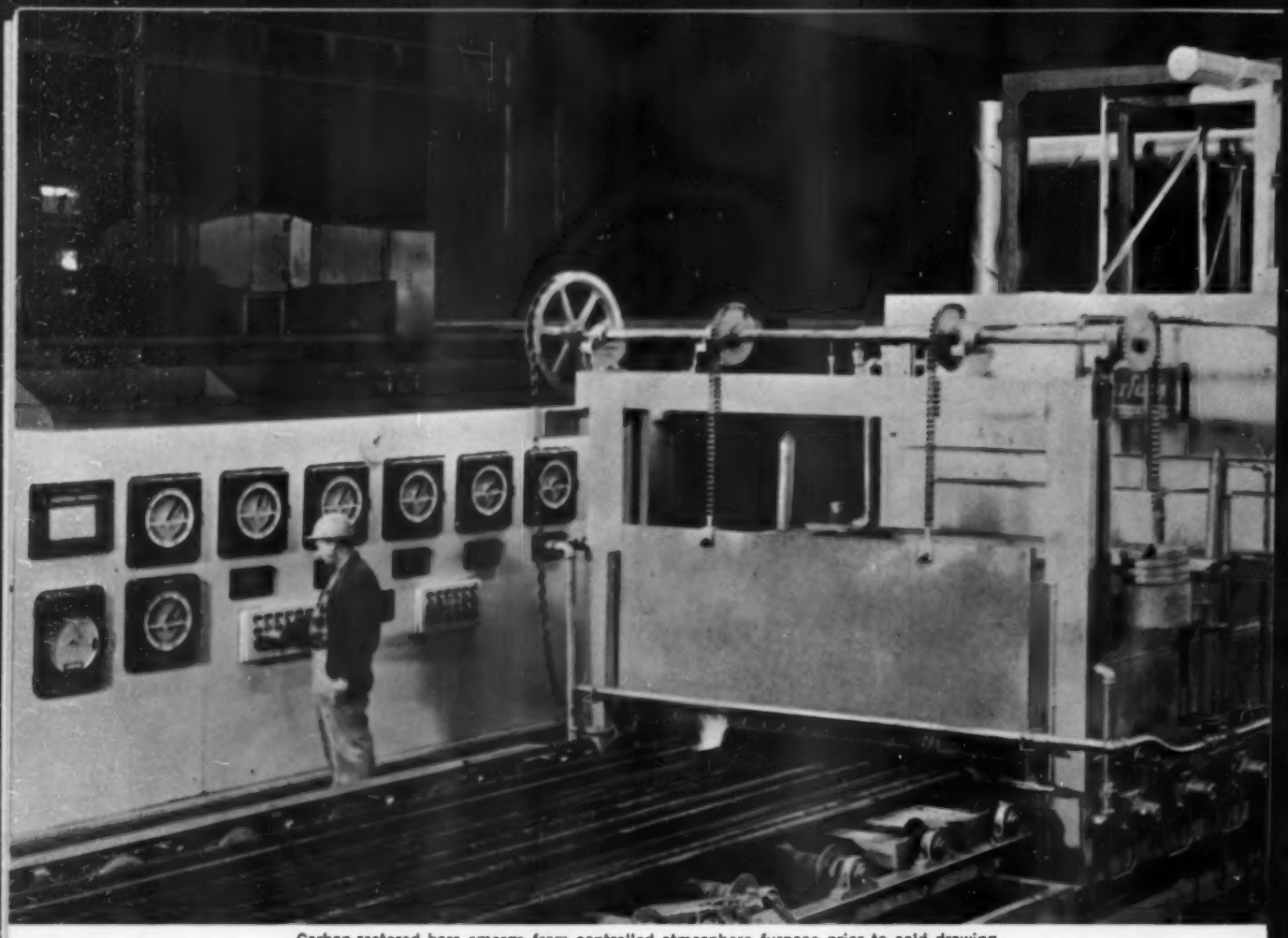
Friden Creates A New World For Business

Friden

FRIDEN, INC., SAN LEANDRO, CALIFORNIA • SALES, SERVICE AND INSTRUCTION THROUGHOUT THE U.S. AND THE WORLD

CIRCLE 200 READER SERVICE CARD ▲

CIRCLE 201 READER SERVICE CARD ►



Carbon-restored bars emerge from controlled atmosphere furnace prior to cold drawing.

J&L announces industry's most modern controlled atmosphere furnace for cold finished bars

This new continuous controlled atmosphere furnace is the latest and most important addition to J&L's wide range of heat-treating facilities for cold finished bars. It makes possible a major increase in production of accurately and uniformly heat-treated cold finished bars – so important to producers of finished parts, who depend upon consistent properties throughout the bar, from bar to bar, and from shipment to shipment. The new furnace provides extremely accurate–yet flexible–control of heating and cooling. Flexibility is made possible by the division of the furnace into several automatically controlled chambers. Bars can thus be treated to match exactly each user's requirements for strength, hardness, and structure. These characteristics can be reproduced throughout different lots of steel. A principal function of the new furnace is carbon restoration annealing; other thermal treatments include bright annealing, spheroidize annealing, and normalizing.

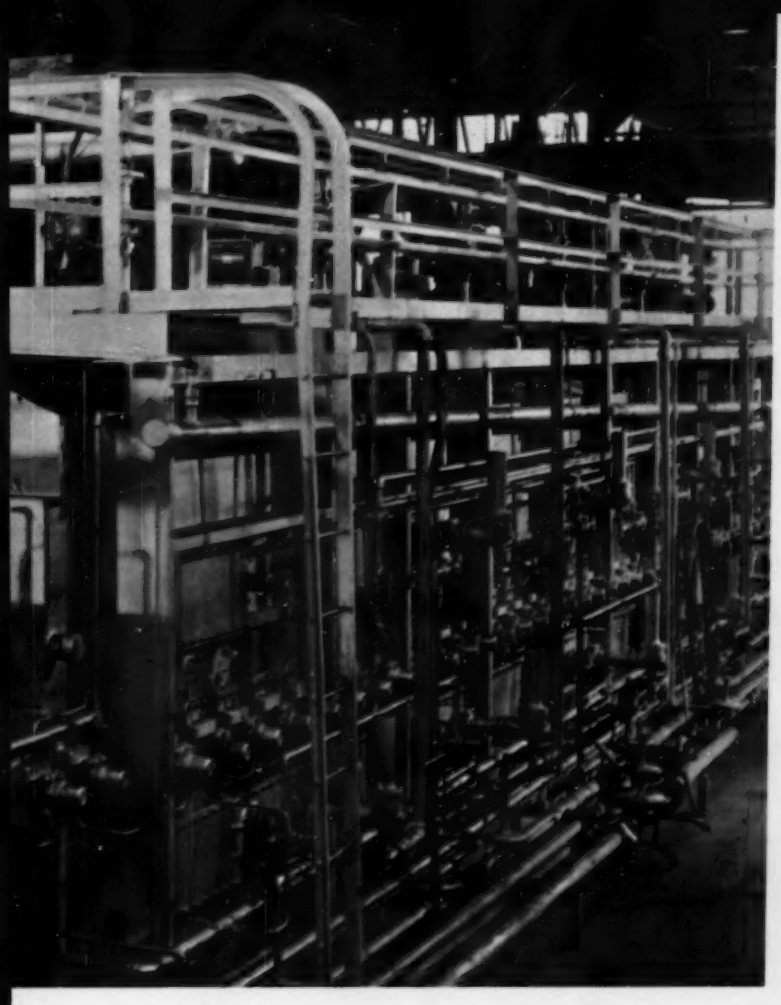
Steel

This Steelmark identifies products made of steel. Place this mark on your products. And — look for it when you buy.

Jones & Laughlin Steel Corporation

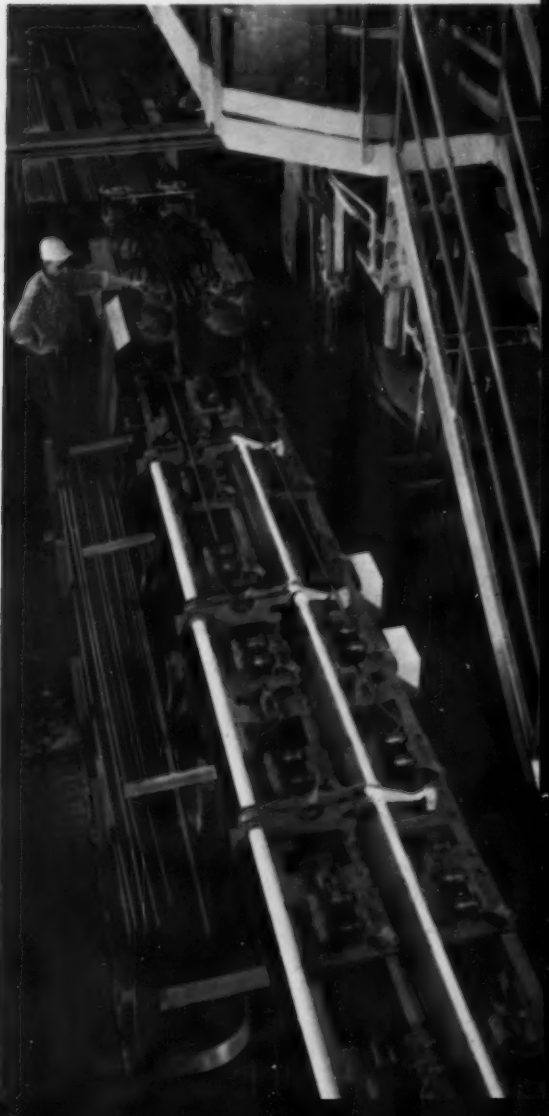
3 Gateway Center, Pittsburgh 30, Pennsylvania

J&L STEEL



This new continuous controlled atmosphere furnace gives J&L greatly enlarged capacity for precision heat treatment of cold finished bar stock. Automatic control of furnace atmosphere, heating, and cooling results in a very uniform structure for the annealed bars.

Electreat is an exclusive J&L method of heat-treating cold finished bars by exceptionally accurate control of heating, quenching, and tempering. Individual bars are fed continuously through an induction coil, then quickly cooled and tempered to obtain desired mechanical properties or hardness. Electreat gives a high-strength bar with superior ductility and uniform hardness. Improved notch toughness enables parts to withstand shock loads in service; provides greater strength than conventionally heat-treated carbon steel at lower cost than alloy steel for many products.



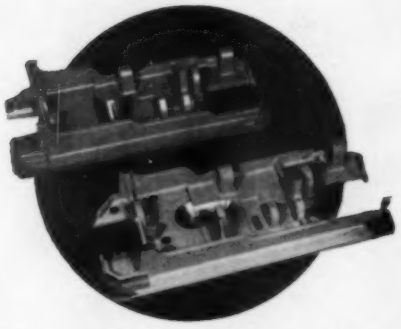
New Holland Machine Company saves on drive shaft cost. By selecting J&L's Electreat C-1144 cold finished bars for the feeder drive shaft of a new hay baler, New Holland Machine Company met high standards for strength while saving money on the cost of the part. Electreat's high minimum yield strength (120,000 p.s.i. required in this case) and uniform hardness eliminated the need to use a larger diameter carbon steel shaft or an expensive alloy steel. Due to the high yield strength and uniform quality of Electreat, New Holland reports very satisfactory field performance from their shafts.

Sub-contracting precision parts, assemblies and machines like these... is our business!

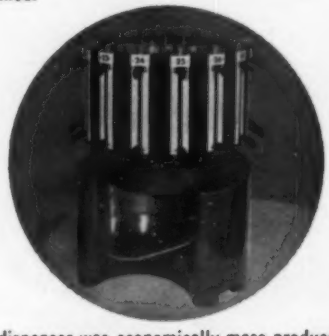
(but we want more of it)

We'd also like to prove to you what our completely integrated manufacturing facilities* can mean to you in terms of lower costs, faster delivery, and complete satisfaction.

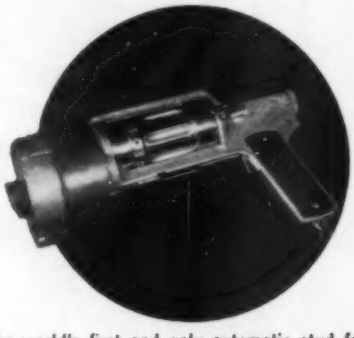
TMW's facilities and 65 years' experience in high-precision (tolerances to tenths) manufacturing are available to you *now*, on a short or long-term basis. For details or a new Facilities File Folder, call or write today.



A TMW gray iron casting before and after precise machining, annealing and finishing operations were performed.



Paint dispenser was economically mass produced for a major manufacturer in TMW's modern shops.

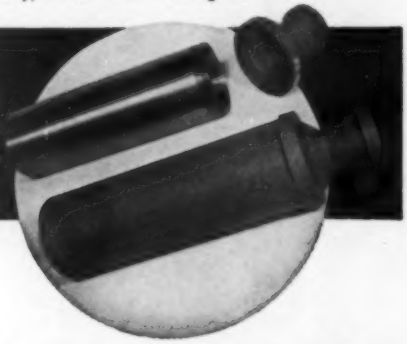


"The world's first and only automatic stud fastener" . . . (another example of TMW precision machining and assembly) carries a LIFETIME guarantee.

* Includes 1,000,000 sq. ft. of manufacturing space, 1200 *modern* machine tools, completely mechanized foundry (one of the world's largest), 3000 skilled craftsmen with a corps of top designers and engineers.

TEXTILE MACHINE WORKS

Contract Division • Reading, Pennsylvania



Jato units, used on the "Honest John" rocket to make it spin, are machined to ±.0002" tolerances and hydrostatically tested to meet strict government specifications.

◄ CIRCLE 202 READER SERVICE CARD

▲ CIRCLE 203 READER SERVICE CARD

INNOCENTI mechanical division

Continuous Mill in operation at DALMINE S.p.A. works in Costa Volpino, Italy

continuous mill

for the manufacture of seamless steel tubes and pipes

The Continuous Mill associated with the Stretch Reducing Mill in the double version for making tubes from $^3/_8$" to 4" and from $2^3/_8$" to 7" successfully meets present requirements for consistently higher quality and quantity.

- Highest Capacity: the annual production can reach respectively 150,000 and 250,000 tons in the two versions.
- Highest yield: 93% - from billet to tube
- Complete automation: 1,5 man hour per produced ton
- Possibility to make tubes with 2,25 mm minimum thickness without stretching
- Extremely easy to operate
- Low installation costs in respect of capacity.

These features make the Continuous Mill the most reliable tube making equipment for new installations or the modernization of the existing ones.

INNOCENTI

MILANO Via Pitteri 81 - tel. 23.93 • **ROMA** Via Parigi 11 - tel. 487.051 • **NEW YORK** 43 West 61 Street - N. Y. 23 - tel. Columbus 5-7795 • **PARIS** 6, Av. F. Roosevelt - VIII - tel. Balzac 03-51 • **LONDON** U.K. Representative-Uganda House - 58/59 Trafalgar Square, W.C. 2 - tel. Whitehall 2075 • **CARACAS** Edif. Sudameris Avenida Urdaneta y Fuerzas Armadas - tel. 545.461

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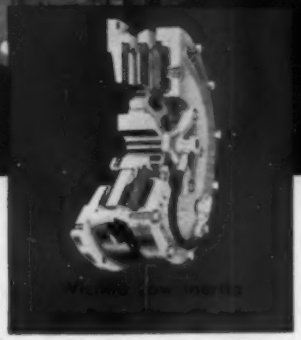
McKAY SELECTS WICHITA CLUTCH AND BRAKE FOR

NEW, AUTOMATIC, HIGH-PRODUCTION DIE SHEAR



Trouble-free, positive-acting Wichita equipment helps cutoff press respond instantly and dependably

The McKaymatic Die Shear Line, in use in warehouses and fabricating plants throughout the world, handles coiled metal in most widths and thicknesses at a top speed of 180 fpm. Especially important in the Line's efficient operation is the Wichita Clutch and Brake on the four column cutoff press. McKay Machine selected Wichita equipment for this severe duty cycle press because it can guarantee one stroke action with a positive stop at the top of the press stroke, and because of the equipment's quick response.

For all types of precision, heavy-duty assignments you can depend on Wichita Clutches and Brakes . . . call on a Wichita Engineer to help you solve your particular drive problem.

Contact your nearest Wichita Engineer.

Clutch & Control Engineering Co., Livonia, Mich.
Fremont & Lewis, Inc., Cincinnati, Ohio
W. G. Kerr Company, Pittsburgh, Pa.
Smith-Keser & Co., Avon, Conn.,
Philadelphia 44, Pa., and New York, N. Y.
Frank W. Yarline Co., Chicago, Illinois
Larry W. McDowell, Long Beach, California
Andrew T. Lobel, Denver, Colorado
Robert R. King Co., Cleveland, Ohio
Norman Williams, Houston, Texas
Allied Transmission Equipment Co.,
Kansas City 8, Missouri
Donald E. Harman, Dallas, Texas
C. Arthur Weaver, Richmond, Virginia
Malcolm S. Cone, Memphis, Tennessee
Dominion Power Press Equipment, Ltd.,
Burlington, Ontario, Canada
R. E. Kunz, Seattle 4, Wash.
Norman Rupp Co., Portland 4, Ore.
Bates Sales Co., St. Louis 1, Mo.

WICHITA Clutch COMPANY, INC.
WICHITA FALLS, TEXAS, U.S.A.

CIRCLE 205 READER SERVICE CARD

HARDINGE
ELMIRA, N.Y

COLLETS - FEED FINGERS - PADS

For Your

Automatic Screw Machines — Turret Lathes —
Chucking Machines — Tool Room Lathes — Millers and Grinders

Write for Descriptive Literature and Prices

Stock Delivery

For: Brown & Sharpe, Cleveland, Cone, Davenport, Greenlee, Acme Gridley, National Acme, New Britain, Warner & Swasey, Jones and Lamson, Gisholt, Bardons & Oliver, Foster, Morey, Simmons, Ames, Atlas, Cushman, Hendey, LeBlond, Pratt & Whitney, Monarch, Bridgeport, South Bend, Kearney & Trecker, Linley, Van Norman, and others.

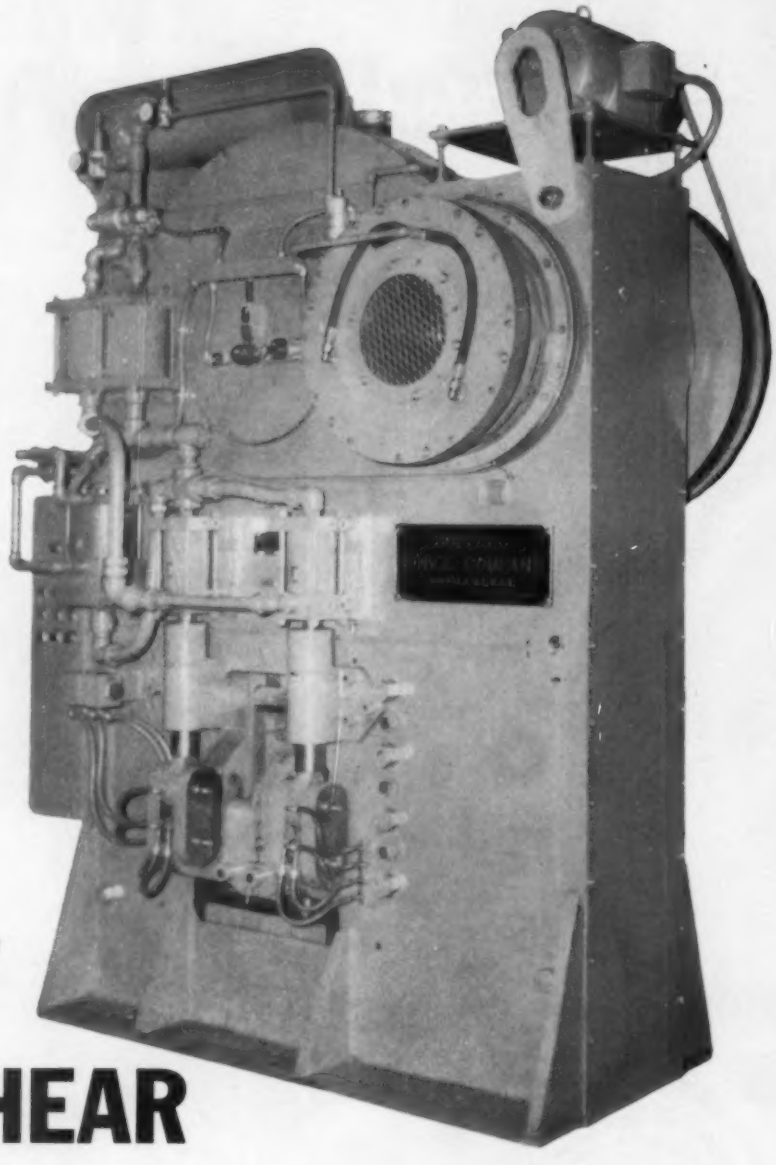
HARDINGE BROTHERS, INC., ELMIRA, N. Y.

HIGH SHEARING SPEED—Up to 18,000 cuts per 8 hour shift.

CLEAN, SQUARE CUTS—Shows up hidden defects.

COMPACT DESIGN—Saves floor space.

AUTOMATIC FEED TABLES—Available to your requirements.



'BUFFALO' BILLET SHEAR

Now—enjoy peak production on your billet cutting jobs. This new 'Buffalo' Billet Shear is ruggedly-built for maximum years of dependable, trouble-free performance. Greatest output at lowest cost is assured by efficient high speed operation. Clean, square cut billets permit high quality finished forgings. Features include alloy steel frame, electrical controls and pneumatic automatic oiling system.

For full details, including capacities available, contact your machine tool dealer or write us direct.

ESTABLISHED 1877 "Buffalo" MEMBER N.M.T.B.A.

MACHINE TOOL DIVISION

BUFFALO FORGE COMPANY

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.

'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.

'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.

Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.

Route Slip

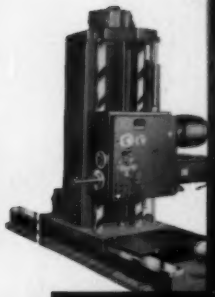
"WE'RE USING TAPE-CONTROLLED MACHINE TOOLS

. . . TO ACHIEVE GREATER PRODUCTION WITH A MINIMUM OF EQUIPMENT SO WE CAN DELIVER BETTER PRODUCTS TO THE GRAPHIC ARTS INDUSTRY AT COMPETITIVE PRICES"

For routing tear out on perforation.

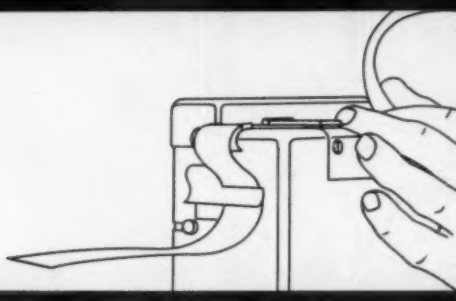
Adrian O. Holmberg
Executive Vice President, Manufacturing
Miehle-Goss-Dexter, Inc.
Chicago, Illinois

Frank M. Bender
Vice President, Manufacturing
The Miehle Company



GIDDINGS & LEV

Route Slip



HOW GIDDINGS & LEWIS TAPE
ON SHORT RUNS AT MIEHLE-GOS

. . . AN INTERVIEW WITH THE MEN WHO TOOK THE
AND SAVED AS HIGH AS $130,000 IN TOOLING FOR J

◀ For routing tear out on perforation.

**Everybody's talking about tape control and inevitably mo
But the lag time between talk and do is penalizing many
in profits annually.**

**Miehle-Goss-Dexter, Inc., Chicago, world's largest manufac
ment, has gone further into tape-controlled machining than
outside the aircraft industry. Their experiences in all phases
justification before purchase to the operating and maintena
a guidebook to other manufacturers who are "looking" at**

**The highlights are told here through an exclusive intervi
Executive Vice President, Manufacturing, Miehle-Goss-Dex
turing personnel of two divisions, The Miehle Company and**

Question. What is the principal effect of numerically controlled machine tools on your manufacturing?

Answer. Numerical control of machine tools has been a real break-through in counteracting continuously rising costs.

In the five years since we bought our first tape-controlled machine, we have made tremendous strides in cost reduction, and the values are becoming more evident every day.

Q. You say you bought your first tape-controlled machine five years ago. How many do you have in operation now?

A. We bought a positioning table first. Now we are operating 19 numerically controlled machines throughout our three divisions. We have five Giddings & Lewis horizontal boring, drilling, and milling machines, including your new 6" model. Incidentally, we believe that a good place to start in tape is with a horizontal machine, both to gain experience and realize immediate large savings.

Q. What prompted you to go into tape?

A. There were a lot of factors. We wanted to do the same or more work with fewer machine tools, to eliminate many jigs and fixtures, and to gain manufacturing floor space.

We operate what are really large job shops — an average run of a part seldom exceeds 50 pieces. Miehle
graphic arts i
specially design
and this sometir

We sought to e
involved in de
maintaining new

750

**Q. Have you r
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A. Yes, indeed
750 fixtures in
have fewer setu
handling. We
improved accura

There are big sa
design change or
It takes from le
40 man-hours t
"tool" with tape
ber of operations

We have a direc
for manually con
machines. Before
Lewis at Miehle,
tooling to produ
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cost of only abou

PE CONTROL PAYS GOSS-DEXTER, INC.

THE COMPANY INTO "TAPE" FOR JUST ONE NEW PRODUCT

y more and more will go into it. nany plants thousands of dollars

anufacturer of graphic arts equip- than all but a few manufacturers hases of tape, from the economic intenance know-how, are literally g" at tape.

nterview with Adrian Holmberg, s-Dexter, Inc., and key manufac- ny and The Goss Company.

Miehle-Goss-Dexter provides the arts industry with many presses designed to customer specifications, ometimes means one-of-a-kind parts.

nt to eliminate the tremendous costs in designing, manufacturing, and ng new jigs and fixtures.

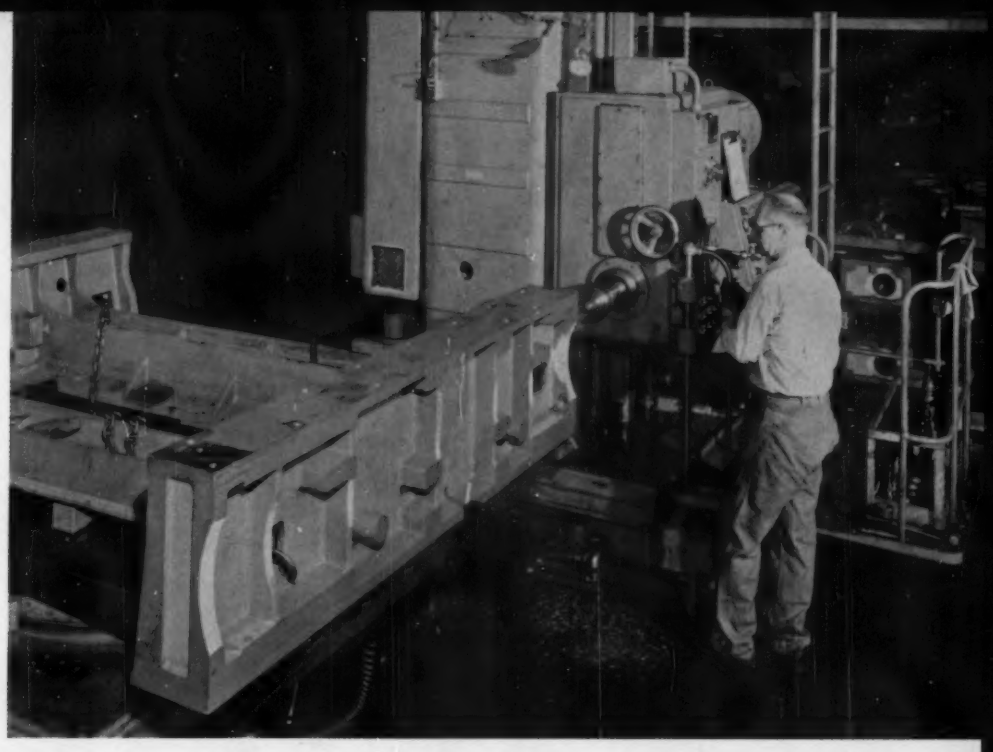
750 Fixtures Junked

you realized the savings and bene- nticipated?

indeed. We have junked more than es in our various divisions. We also r setups per piece and less material We have saved floor space and accuracies.

big savings whenever we get a part nge or a new model machine to build. rom less than one man-hour to, say, ours to process a manuscript and h tape — dependent upon the num- rations to be performed on the part.

a direct comparison on tooling costs lly controlled versus tape-controlled Before we bought the Giddings & Miehle, we spent close to $150,000 for produce a certain product. Later for almost an identical product to ed on the Giddings & Lewis for a y about $20,000.



Q. On this tooling question, you eliminate jigs for positioning the tool, but what about workholding fixtures?

A. For the most part, we completely eliminate these, too. Because Industrial Engineering and Manufacturing study and establish the location of the part on the table, we often are able to use standard angle plates and locating stops as holding fixtures.

On some of the G&L's we use your air-lift rotary tables so only one setup is required.

Faster, Lower Cost Assembly

Q. Any other advantages of numerical control?

A. Accuracy and true duplication of parts. This insures quality of product and brings costsavings on the assembly floor. Everything lines up now. Assembly goes faster and easier.

Additionally, we eliminate other types of machine tools. For example, on certain parts we formerly did important holes on the jig borer — then sent the work to the layout bench. Even then we had fitting problems. Now we do this work with G&L machines and make truly interchangeable parts.

Walter G. Schalk, manufacturing engineer, The Miehle Company, Division of Miehle-Goss-Dexter, Inc.

Russell L. Hogin, machine tool co-ordinator, The Goss Company, Division of Miehle-Goss-Dexter, Inc.

Q. How accurate are your machines?

A. Our G&L machines consistently provide ±.001″ repeatability on hole center dimensions. This accuracy has eliminated many checking operations and gages.

Tape Preparation

Q. Will you explain briefly the programming and preparation of the punched paper tapes?

A. These procedures are quite easily learned. It is important though that various departments become oriented and think in terms of tape-controlled machining.

First, it is desirable to have the Engineering Department put co-ordinate dimensions on their drawings for any operations to be performed under tape control.

Working from this type of dimensioning the Industrial Engineering Department uses standard forms to show workpiece location on the machine table, spindle location, speed, feed, type of tool, depth of feed, and explanation.

A fast, accurate typist transfers the industrial engineer's data to a master operations sheet in duplicate, using a typewriter which simultaneously punches a master tape and an auxiliary machine code tape.

The master tapes and sheets are filed.

Q. What type of personnel are best qualified to handle programming for tape operation?

A. Those who know something about shop practice. No special personnel are required.

Industrial engineers are well qualified. In one plant we have a man from Methods who formerly did checking on tool drawings. Another was formerly a plant layout man. Still

Russell L. Hogin compares $12,111.48 in jigs "traded" for $513.20 worth of tapes! This is a typical saving made with a G&L Numeripoint-controlled machine by The Goss Company in machining the first of each of 17 new printing press parts.

GIDDINGS & LEWIS

another of our programmers had but six months' experience in our shops, yet mastered the job within a month and a half.

Q. About how many tapes have you made?

A. We have made and are using more than 12,000 different punched paper tapes in our plants. You can see that we have a lot of parts being produced under numerical control. Here is where a little paper work really pays off.

Q. Do you make one-of-a-kind parts under tape control?

A. Whether you make a tape depends upon the number of machining operations to be performed on a part, as well as upon the number of parts. Often we make a tape for only one part, particularly where high accuracy is required, or if we expect that we may ever be required to make a duplicate.

Of course, with the digital dial control on your Model 3045 horizontal, we can manually dial in the spindle position with the same accuracies as with tape. We frequently use this control for making one-of-a-kind parts or for very small runs where only a few holes are to be located on each surface. But if as many as six or eight holes are to be located on a surface, we find it is better to make a tape.

Q. Whom do you use for numerical-control system maintenance?

A. This presents no problem. Our regular electricians can handle it. The systems are becoming increasingly reliable. In a recent three-month period, we had 2,053 hours' running time out of a possible 2,223 for two machines, and that includes downtime for both machine and control maintenance.

Economic Justification

Q. What are the possible savings on your Giddings & Lewis machines?

A. We are saving anywhere from 10% to 40% over our previous methods, which were those commonly used today throughout the metalworking field.

We especially like the Giddings & Lewis machines because of their ease of operation and handy controls. You don't have to fight the job all day long. The floor-type machine also is very good for us because it gives us great flexibility in handling large or small parts.

Q. Would you care now to summarize the benefits of tape-controlled machining?

A. There are a number, as we have discussed. You get true interchangeability of parts. No hand rework on the assembly floor. Responsibility for accuracy control is put in the hands of the engineers. Chance for operator error is almost entirely eliminated. Many checking operations are eliminated.

Tooling costs are greatly reduced. Floor-to-floor time is reduced as much as 30 to 50%. Over-all manufacturing costs are lower.

We get big savings on prototypes — the first of a new type of machine. These sometimes call for modifications later — easy to make with tape.

Fewer machine tools are required to do the same amount of work. Savings in floor space are significant.

Last, but not least, there is less operator fatigue and less chance for errors. The operator observes predetermined specified operations of the machine instead of performing all the positioning and other work required with manually operated equipment.

Tape control really is management control of production. All in all, we don't see how any plant with short runs can afford not to use numerically controlled machine tools.

If you've been thinking about tape, there's no time like the present to discuss it with Giddings & Lewis — the people who built the first commercial tape-controlled machine tool and who have shipped more major machines with numerical control than any other manufacturer. Consult your local G&L distributor or write.

GIDDINGS & LEWIS

GIDDINGS & LEWIS MACHINE TOOL COMPANY, Fond du Lac, Wis., Est. 1859

Jig borers and milling machines; horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; positioning tables; die sinking machines; contour milling machines; radial and upright drilling machines; planers; planer mills; numerical and tracer control systems; Davis boring tools.

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It's that easy. Like calling your own stock room and having what you need sent over—aluminum bolts, nuts, rivets, machine screws, wood screws, sheet metal screws, washers, whatever your job calls for in standard sizes and types!

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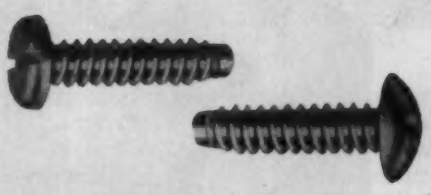

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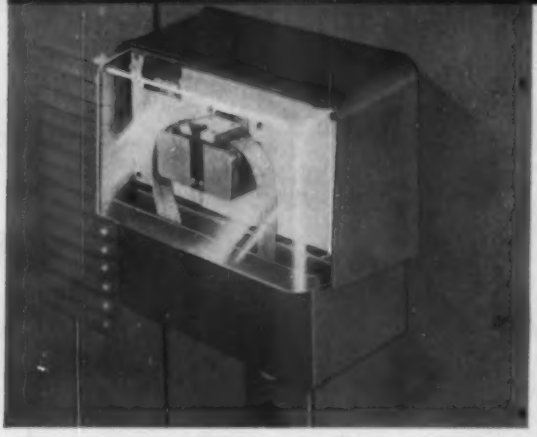
NEW-WARNER & SWASEY 1AC SINGLE SPINDLE CHUCKING AUTOMATIC WITH NUMERICAL TAPE CONTROL

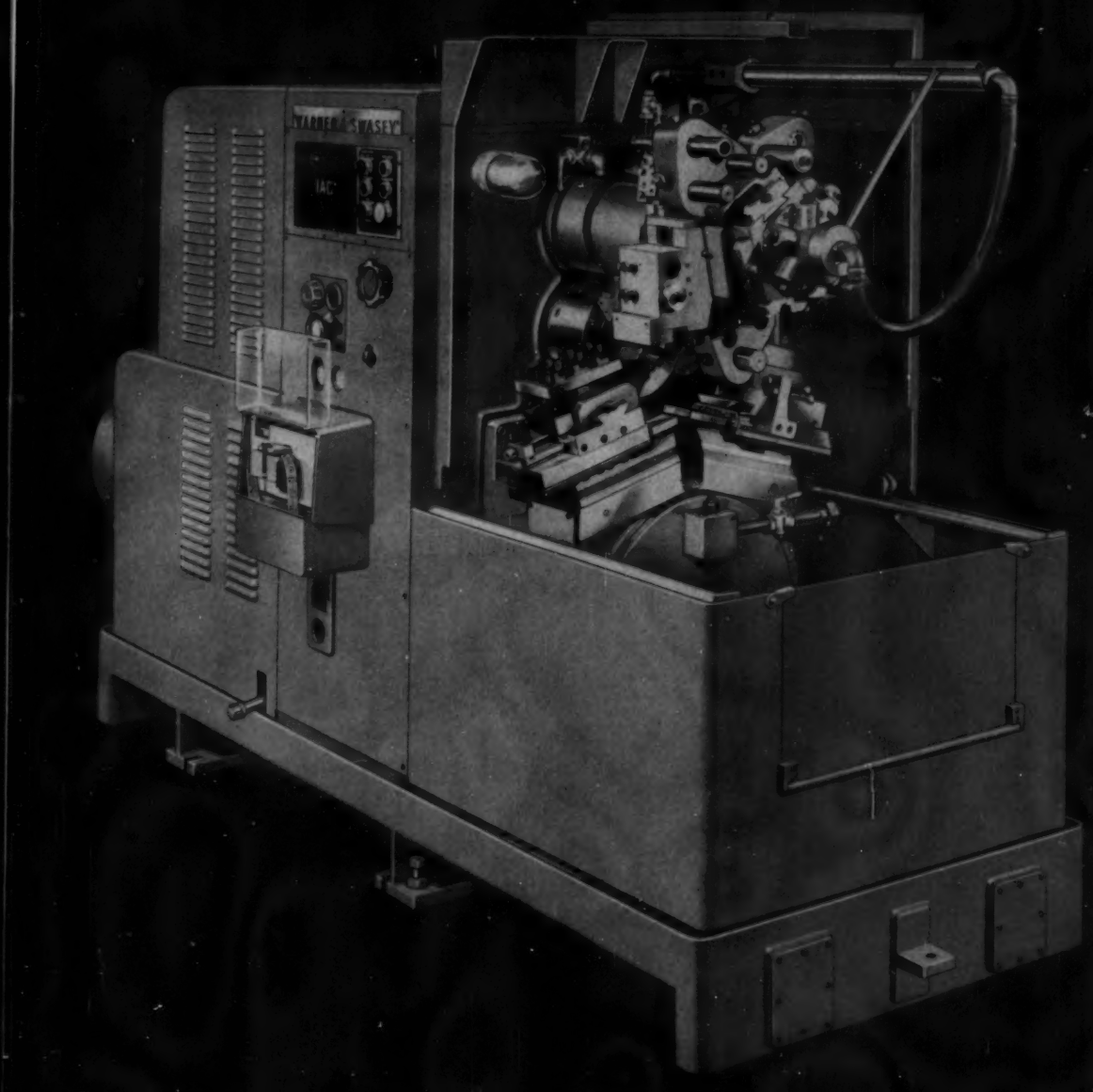
CONVERTIBLE IN MINUTES

FROM TAPE CONTROL... TO STANDARD AUTOMATIC CONTROL



Punched tape inserted into this tape reader provides a pre-planned program of standard 1AC automatic functions. This permits an engineered sequence of speeds, feeds and cutting stroke lengths for controlled production efficiency.

When tape control is not desired, standard automatic control of speeds, feeds, cutting stroke lengths can be rapidly set up by the simple placement of numbered trip blocks on the Main Control Drum as shown here.



NOW—you can have all the recognized production advantages of the W/S 1AC Single Spindle Chucking Automatic PLUS Tape Control PLUS Convertibility of Controls that add greatly to day-to-day operating flexibility. It takes but a few minutes to switch from one type of automatic control to the other. The 1AC need never stand idle waiting on the tape for a job. This convertible automatic control feature is particularly beneficial to users just learning the ins-and-outs of tape control. There is no lost production while gaining experience in the preparation of tape, and jobs can be *gradually* converted to tape control.

This machine enlarges your opportunities for handling small and medium size lot work on an automatic basis. Close tolerances—from first piece to last—are routine due to the built-in rigidity and accuracy of these 1AC's. And they have the power and speed to get the most out of advanced cutting tools and methods.

Some other production advantages your W/S Field Engineer can enlarge upon are: complete cross slide flexibility—hand control of automatic functions—single station operation—and a number of others. Warner & Swasey Co., Cleveland 3, Ohio.

You can produce it better, faster, for less . . . with a Warner & Swasey

Precision lathes for tape, tracer, or operator control

Here you see the core of the new Barber-Colman lathe line. To prove the *new* ideas claim, take just two examples, the Tape-r-guide (directly below) and the 1610 tracer lathe (lower right, opposite page).

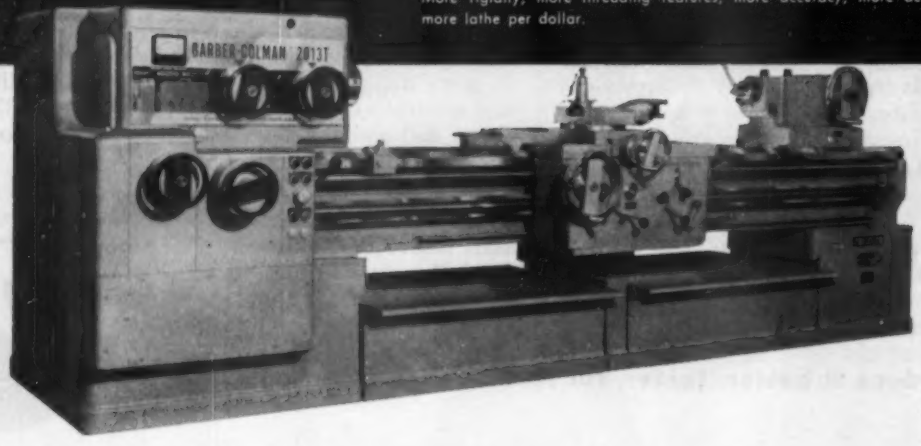
News about the Tape-r-guide? Without complex electronics, with just electromechanical controls, this machine can do cutoff and boring as well as internal and external step-turning, smooth tapers, and even some radii. Simplicity itself, it does its work with a single-point tool . . .

The new ideas in turning

new

NEW Tape-r-guide (16" and 20"), first basically mechanical lathe with fully integrated 8-channel binary code control system. Automatically performs stop-start, positioning, speed adjustment, and feed change functions; machines all practical tapers without "hunting" or step formation; produces simple radii; cuts chamfers without special tools; performs cutoff and boring operations and machines at 90° to the work axis — all without feedback or complex electronics. Low capital equipment investment — simple, low-cost operation and maintenance.

NEW 2013, 36-speed lathe (21" and 25") — All-new, geared-head precision lathe for high-speed production or toolroom turning . . . used in production shops with throw-away insert tools at speeds up to 750 sfpm. For fast, accurate production of medium- and short-run jobs. Spindle speeds to 1500 rpm (200 rpm optional); 66 thread cutting and feed changes; 400-lb, two-speed tailstock; separate lead screw and feed shaft. More rigidity, more threading features, more accuracy, more design refinements — more lathe per dollar.



new

completely controlled by the tape.

And about the 1610 tracer? This is the "specialist," a concept which for the first time strips off the toolroom equipment and offers a facing and turning lathe that is frankly a production tool. Tracer control multiplies its productivity by making it semiautomatic.

Both these new machines are innovations, and are signs of the unencumbered thinking that goes on at Barber-Colman. It is part of the heritage that has brought to Barber-Colman precision lathes such important design advantages as sealed gearboxes, controls that are simplified and grouped, hardened and ground bedways, the use of precision antifriction bearings, and universal automatic lubrication.

You can continue to expect significant design contributions such as these in the lathes Barber-Colman will build in the years to come. But meantime, take advantage of the increased productivity of the machines offered today.

A good way to start is to call your Barber-Colman representative.

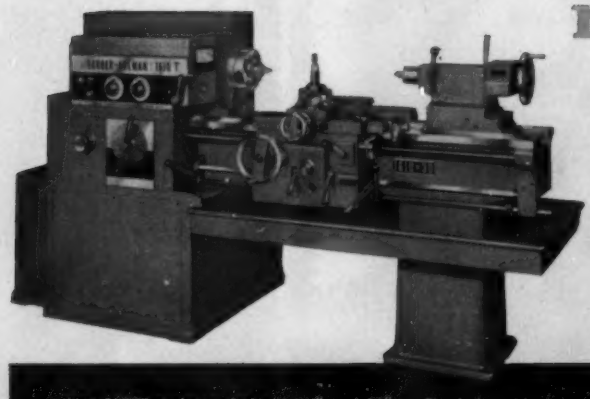
Barber-Colman Company

BARBER COLMAN

101 Loomis St., Rockford, Illinois

are from Barber-Colman

new



NEW 1610T toolroom lathe (16½" and 20") — The lathe with the "toolroom touch." The minute you push the start button and grab the handwheel, you feel the difference toolmakers look for. Try the speed change dial for fast facing or a light finishing cut on the OD. Smooth, silent, fast acceleration under load — infinitely variable speeds to 1500 rpm in the high range.

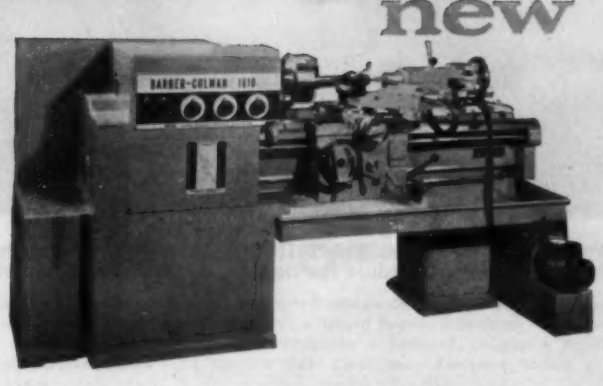
NEW 1610 specialist (16½" and 20") — Proven new concept reduces both capital equipment and operating costs. For high-speed turning, facing, and boring. Class B operators readily become proficient at producing accurate nonthreaded parts up to 100% faster. Infinitely variable spindle speeds to 1500 rpm; infinitely variable power feed to both carriage and cross slide; five-position turret-type longitudinal feed stop — reduces skill requirements and speeds operation.

NEW 1307T toolroom lathe (13") — High capacity and timesaving controls combined with super precision. Infinitely variable speeds to 3000 rpm in belt drive can be changed under load. Combines extra capacities (13" swing and 24" between centers) with extra quality: selected Class ABEC-7 super-precision spindle bearings; ground-from-the-solid actuating screws; antifriction bearings on all shafts; Meehanite castings; hardened-and-ground headstock gears; splined shaft connections.

NEW 1610 tracer lathe (and 1610-13) — Can be purchased with hydraulic tracer for about the same price as a toolroom lathe of the same rated capacity and quality. Real cost-busting combination of "specialist" lathe and tracer control capable of holding diameters within 0.001".

new

new



FROM CREATIVE CRUCIBLE: HIGH SPEED STEELS THAT MAKE BETTER TOOLS POSSIBLE

AN INSPECTOR CHECKS A "BOTTOMING" TAP for accuracy of the rake of the cutting face. Rex High Speed Steels help tapmakers produce the clean, accurate cutting edges so vitally needed in today's taps.

TODAY'S TRUE-RUNNING TAPS
"TIGHTEN-UP" TOLERANCES

They produce more accurate threads—for closer fits
—because of continually-improved Rex® High Speed Steels

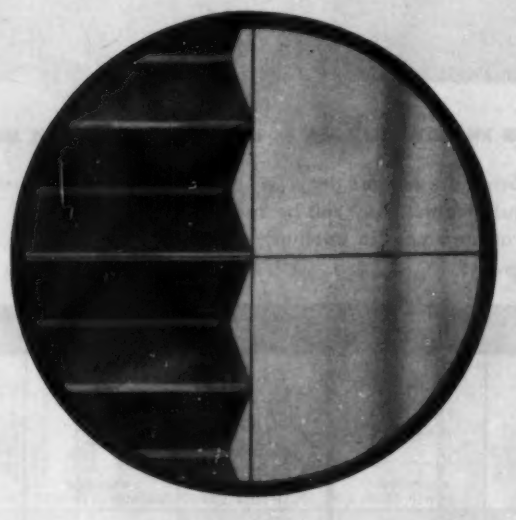
The ground-thread taps you now use produce more accurate threads—*and last longer*—even when tapping tough abrasive materials or today's high-strength alloys.

There's a story behind this development of more accurate and productive taps. It's the story of the tapmakers' continuing research and increasing skill—combined with Crucible progress in making better high speed steels.

To produce the fine steels needed for taps, Crucible tool steel specialists now use the most advanced electronic instrumentation available. For example: they can record the temperature of the molten metal in the melting furnace within 5 seconds. So, each heat is produced under identical temperature conditions.

Crucible specialists employ new techniques that also greatly improve deoxidation of the liquid steel. They use new ingot mold designs to minimize segregation. And they ultrasonically inspect every billet of Rex High Speed Steel before rolling or forging to ensure freedom from internal voids, flake, inclusions, etc.

For complete information on how Rex High Speed Steels can help make precision tools better, call or write Crucible branch office or service center near you.



THE RAKE ANGLE of a ¾-10 H5 "bottoming" tap looks like this — when viewed through the rake measuring instrument shown at left.

BETTER TOOLS, THROUGH BETTER STEELS. The constant improvement of Rex High Speed Steels ensures the increasingly better performance of hobs, broaches, twist drills, cutters and taps.

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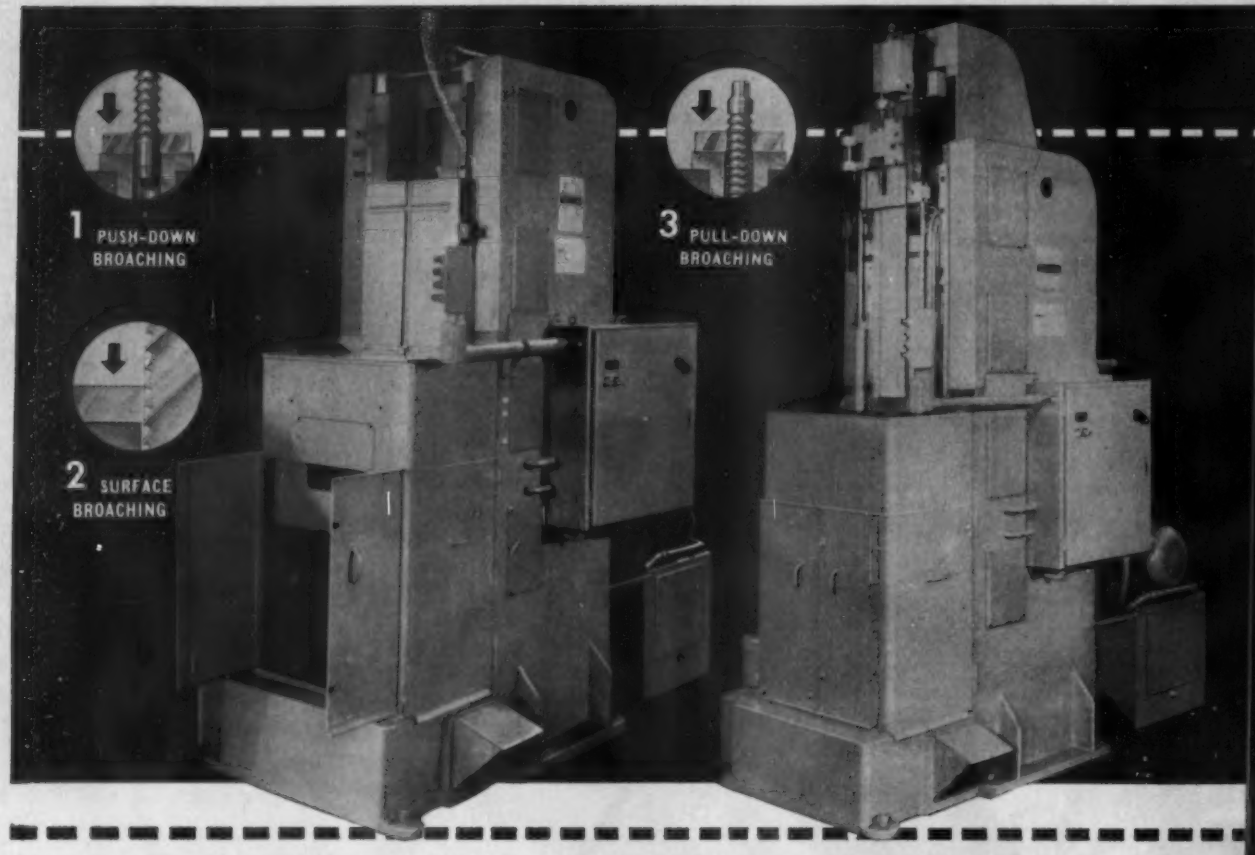
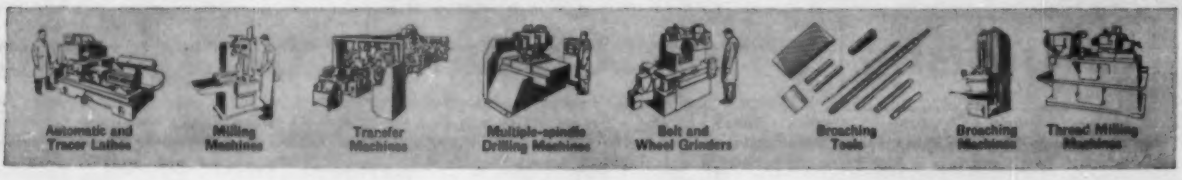
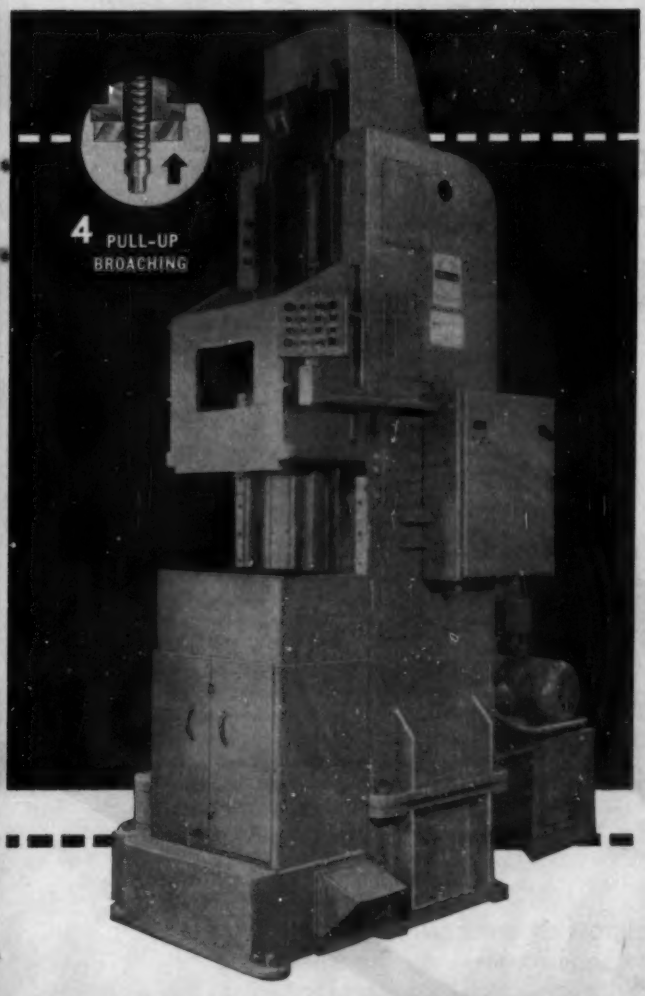


New Sundstrand-American vertical broaching machines provide built-in protection against obsolescence due to changing work requirements. They can be converted at moderate cost in a matter of hours from any one arrangement to another — push-down, pull-down, pull-up, or surface broaching.

TYPE OF MACHINE	BASIC MACHINE UNITS (Standard for Each Stroke Tonnage Size)				CONVERSION ASSEMBLIES REQUIRED			
	COLUMN	SLIDE	HYDRAULIC CYLINDER	HYDRAULIC POWER UNIT	PUSH-PULL LUG	HYDRAULIC BROACH RETRIEVER	SUB-BASE	
PUSH DOWN								
SURFACE								
PULL DOWN								
PULL UP								



BROACHING MACHINES



. . . new Sundstrand-American machines can be converted at moderate cost to meet any vertical broaching requirement

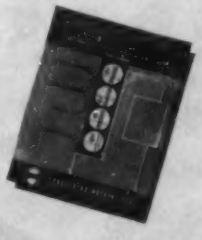
Each machine consists of the same four basic units: 1. machine column with hardened-and-ground rectangular ways, main cylinder mounting, and chip base; 2. broaching slide; 3. hydraulic cylinder unit; 4. hydraulic power unit. These four elements, together with interchangeable conversion assemblies shown in the chart below, make possible the simplified change-over.

Three types of worktables — fixed, sliding, and tilting — are available for surface broaching operations. The fixed table also is used for internal pull-down, pull-up, and push-down work.

The new machines are built in single- and dual-ram models, the dual units having a wider column which carries two complete main cylinders, guide ways, slides, and tables.

Both types are built in 5, 10, 15, 25, 40, and 50-ton capacities, with strokes from 30″ to 90″, depending on tonnage — 22 stroke-tonnage combinations in all. All operations are from a pushbutton station.

A wide variety of pull heads, in addition to Sundstrand-Engineered fixturing and broaching tools are available to insure maximum productivity on any broaching arrangement.



For complete information, write for new Bulletin 120.

CONVERSION ASSEMBLIES REQUIRED			
	FIXED TABLE	SLIDING TABLE	TILTING TABLE
	■		
		■	■
	■		
	■		

SUNDSTRAND

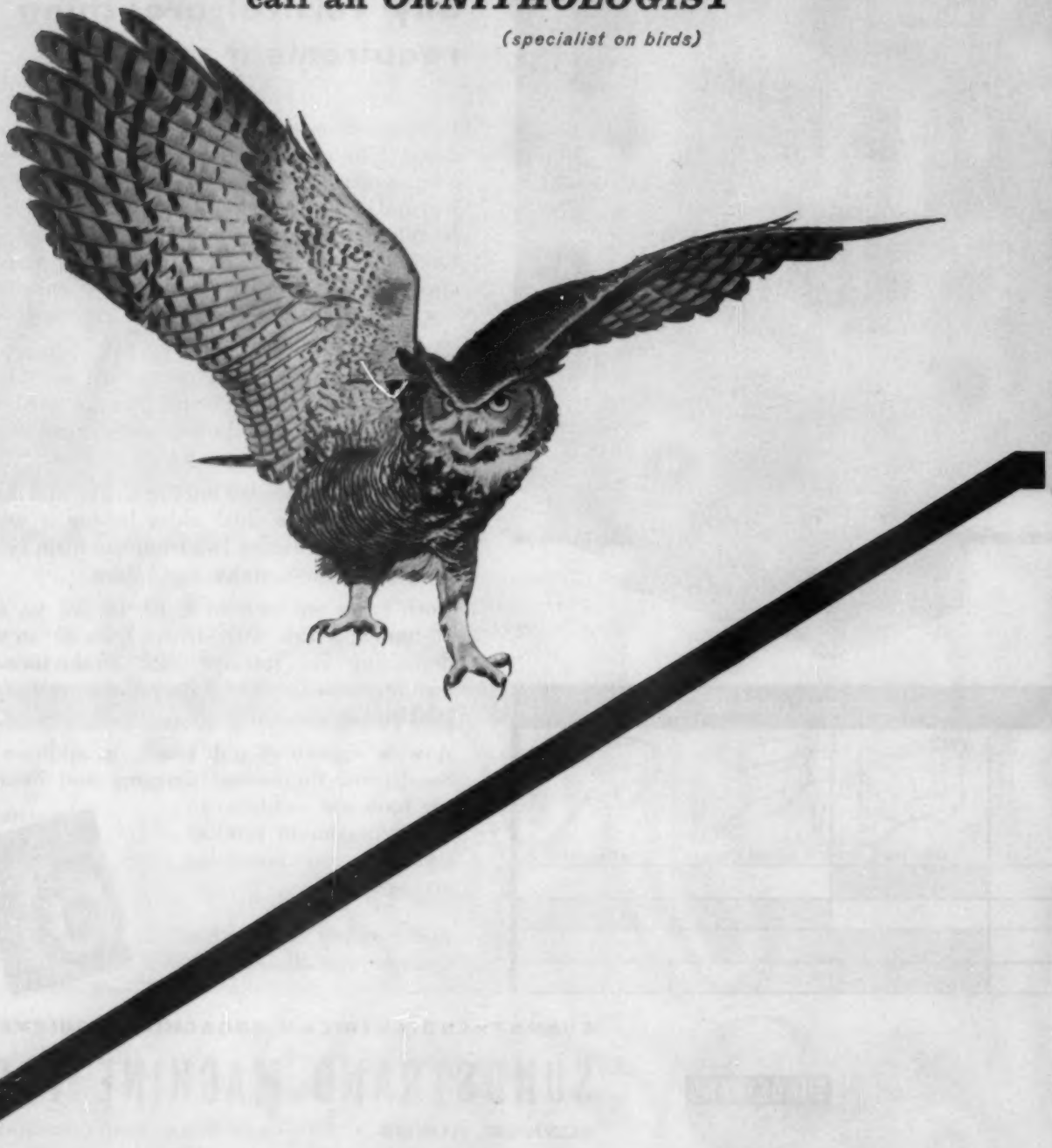
SUNDSTRAND-AMERICAN BROACHING EQUIPMENT

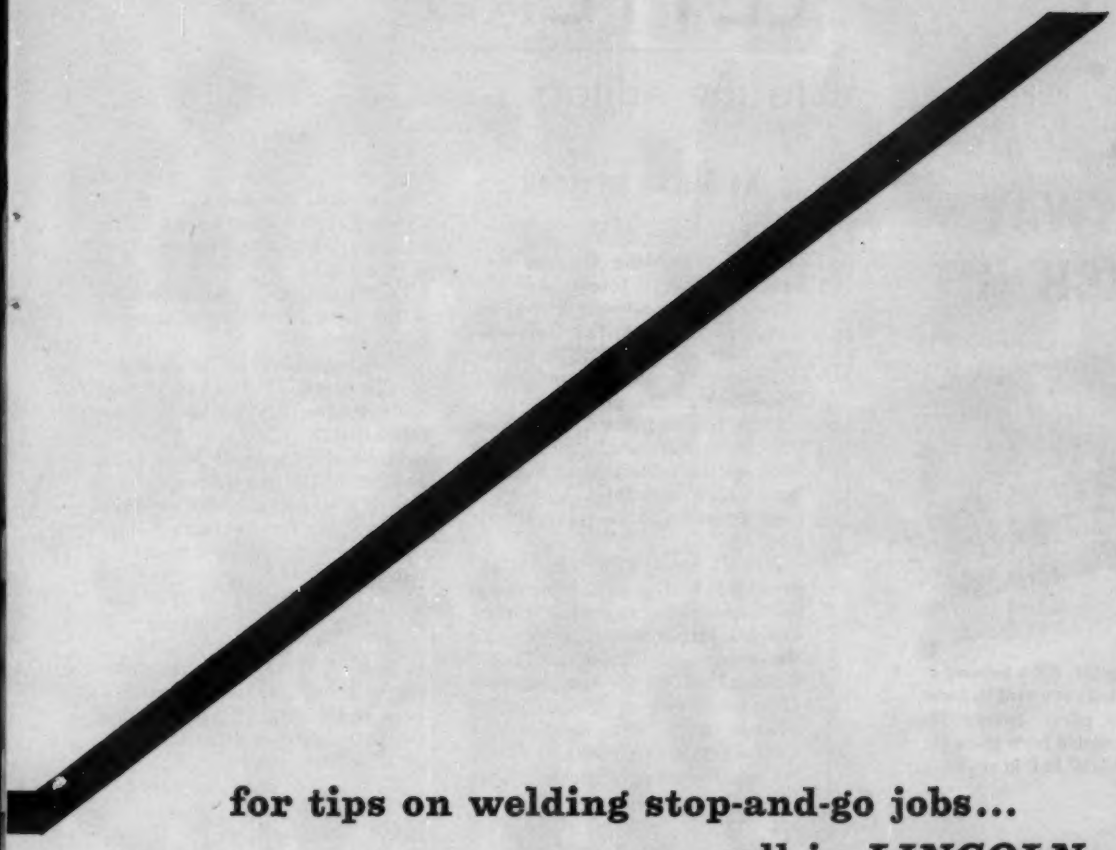
SUNDSTRAND MACHINE TOOL

BELVIDERE, ILLINOIS • DIVISION OF SUNDSTRAND CORPORATION

For tips on finding the Great Horned Owl...
call an *ORNITHOLOGIST*

(specialist on birds)





for tips on welding stop-and-go jobs... call in *LINCOLN*

(specialists in arc welding)

A KANSAS MANUFACTURER OF MOBILE HOMES doubled the welding speed on his undercarriages by simply changing electrodes—and in addition, saved over $8000 in the first year.

Manufacturing cost on undercarriage fabrication was prohibitive. Thirteen gauge cross members were welded to twelve gauge channels by welds made in both vertical and flat positions. These short welds on steel having some scale and oil slowed down production.

Finally they called in their LINCOLN Field Engineer. Painstaking tests, made by the LINCOLN man with the welding foreman and plant superintendent, proved LINCOLN's Fleetweld 37 electrodes far better for this application.

RESULTS: lower costs . . . welding speed doubled . . . cleaning time cut in half.

That's why we say it's a good idea to do business with LINCOLN where arc welding is a specialty and cost reduction comes to you as a "plus" at no charge.

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Save Time With

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Starting with a round pilot you can finish an accurate square hole in one pass in less than one minute. Hexagon and round broaches also available.

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LETTERS

to the editors

330 W 42nd St, New York 36, NY

No Slight Intended

Dear Sirs:
In your interesting Chicago Exposition Issue I found also the comments by Professor Trinks on G Vieregge's book, *Die Zerspanung der Eisenwerkstoffe* (Machining of Ferrous Metals) (AM/MM—Aug 22 '60, p635).

From his comments, I conclude that he is not familiar with my book on the principles of machining, which antedates Vieregge's book by some 30 years (first edition).

I don't have Prof Trinks' address, but I suppose that he would be interested to read what AMERICAN MACHINIST said in 1955 about the second edition of my book, *Grundzüge der Zerspanunglehre* (Fundamentals of Metal-Cutting Science and their Application) (*AM*—Feb 28 '55, p206).

I am therefore enclosing a reprint of the review by *AM*, asking you to forward it to Prof Trinks with my compliments.

Dr Max Kronenberg,
consulting engineer
Cincinnati, Ohio

Dear Sirs:
Thank you for sending me Dr Kronenberg's letter, in which he intimates that I am not familiar with his book.

On the contrary, I bought a copy of his book immediately after its publication.

Dr Kronenberg is the inventor of the word *zerspanung*, which really means "destruction by chip-formation."

While in charge of Mechanical Engineering at the Carnegie Institute of Technology, 1905 to 1942, I tried to broaden mechanical engineering by including a course on tool engineering.

W Trinks
Ohiopyle, Pa

Professor Trinks said in his review that he has not run across any book in the English language that treats the subject as exhaustively as does Vieregge's.

We'd like to point out that both Dr Kronenberg and Vieregge published their books in the German *language. Therefore, the review does not imply any comparison between the two*—Ed.

(Continued on page 76)

SHOPMATES

N. Jarvis

COOLANT IS THE MOST IMPORTANT THING — DON'T FORGET THE COOLANT !! TOOL WILL BURN RIGHT UP IF YOU FORGET THE COOLANT — LOTS OF COOLANT.... COOLANT — DON'T FORGET ETC !!
I FORGOT TO TURN ON THE COOLANT !!
N. JARVIS

We baby these sheets to do a man's job

Here goes a coil of Bethlehem sheets, sinewed to stand up under rugged duty, as only steel can. To bring sheets to this superlative condition, Bethlehem pampers them like a newborn babe.

From open hearth to shipping room, their progress is checked under the watchful eyes of man and X-ray. Slabs are expertly scarfed. Reheating is controlled by the latest scientific instruments. Rolling and coiling temperatures are carefully controlled.

The finished sheet—whether hot-rolled or sent through the 10 additional steps of cold-rolling—is the result of meticulous care all along the way. You can *always* count on Bethlehem sheets to do a man's job! Put them to the test in your plant.

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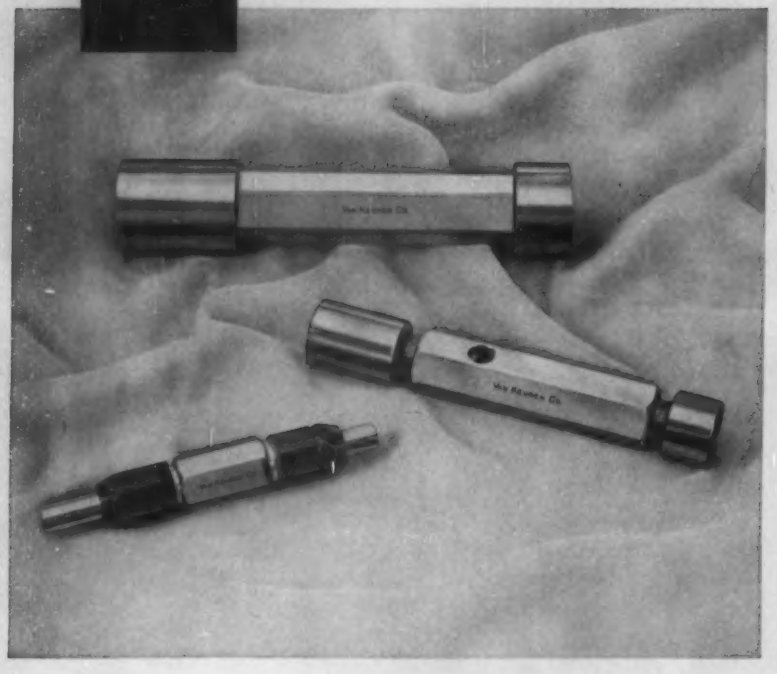
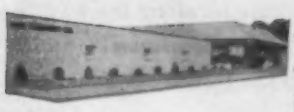


For those who require precise measurements



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Precision Lapping Service and Parts

A Visit to Krupp

Dear Sirs:
I read the anecdote about the Krupp Gun Works by Bess Ritter (*AM/MM*—May 30 '60, p134), but I think I've read a better one—more amusing, at any rate. It's taken from a book by Claud Cockburn, *Nine Bald Men.*

D J Fishlock
London, England

After reading the item that Reader Fishlock sent us, we had to agree with him. Then we made arrangements with Rupert Hart-Davis, Ltd, the publisher of Nine Bald Men, *to reprint the excerpt.*

Actually, it's an illustrative incident lifted from an essay in that book. It's too long to fit in this column, but we like it enough to deviate from our usual practice; this item will be continued in the back of the magazine—Ed.

. . . Which is what happened to me when, as a correspondent of, I think, *The Times*, I went to Essen or thereabouts to visit the Krupp works, and if I'd had more presence of mind I'd have averted or at least postponed World War II.

So I had this lunch with a dozen or so of the Directors and Managers, some of whom looked like wolves and some others rather more like hogs. Or, to put it another way, they looked like the Directors and Managers of a German armament firm.

(Continued on page 220)

"My boss is the best natured guy in the whole world if you happen to catch him in the right mood. Why, I remember one afternoon in 1946 . . ."

CALENDAR

American Gear Manufacturers Association — Semi-annual Meeting, Oct 24-26, Edgewater Beach Hotel, Chicago, Ill.

American Standards Association — National Conference on Standards, Oct 25-27, Sheraton-Atlantic Hotel, New York, NY.

Material Handling Institute—Central States Show, Nov 8-10, Kentucky Fair and Exposition Center, Louisville, Ky.

Society of Die Casting Engineers—National Die Casting Exposition and Congress, Nov 8-11, Artillery Armory, Detroit, Mich.

American Society of Tool & Manufacturing Engineers—Western Tool Show and Convention, Nov 14-18, Sports Arena, Los Angeles, Calif.

American Society of Mechanical Engineers — Winter Annual Meeting, Nov 27-Dec 2, Statler Hilton Hotel, New York, NY.

Joint National Symposium on Reliability and Quality Control, Jan 9-11, Bellevue Stratford Hotel, Philadelphia, Pa.

Society of Automotive Engineers—International Congress and Exposition, Jan 9-13, Cobo Hall, Detroit, Mich.

Instrument Society of America—Instrument-Automation Conference & Exhibit, Jan 16-19, Kiel Auditorium, St Louis, Mo.

Society of the Plastics Industry—Reinforced Plastics Div Conference, Feb 7-9, Edgewater Beach Hotel, Chicago, Ill.

Society of Automotive Engineers—National Automobile and Production Meetings, Mar 13-17, The Sheraton-Cadillac, Detroit, Mich.

American Society for Metals — Western Metal Show, Mar 20-24, Los Angeles, Calif.

Pressed Metal Institute — Spring Technical Meeting, Mar 22-24, Belmont Plaza Hotel, New York.

American Welding Society—Annual Meeting and Welding Show, Apr 18-20, Commodore Hotel, New York, NY.

JARVIS UNVEILS A REVOLUTIONARY DESIGN IN COLD FORMING TAPS!

NEW JAR-FLO

LUBE-GRUV® TAPS

LUBRICATION GROOVES MAKE CHIPLESS FORMING OF INTERNAL THREADS AS EASY AS CONVENTIONAL TAPPING!

NOW, for the first time, cold forming taps that give *full time lubrication* to the *forming contact* area during the *full* tapping cycle.

LUBE-GRUV® gives you a *far superior finish* on the formed threads than is possible with conventional cold forming taps.

USE CONVENTIONAL TAPPING EQUIPMENT. The combination of *positive lubrication* and *narrow contact* surface makes the forming of internal threads much easier than with ordinary cold forming taps. Jar-Flo with LUBE-GRUV has less drag, requires less driving torque.

SEE US AT BOOTH 227 WESTERN TOOL SHOW

LUBE-GRUV® Jar-Flo TAPS FOR CHIPLESS FORMING INTERNAL THREADS IN DUCTILE MATERIALS—STRONGER THREADS—NO CHIPS—AVAILABLE IN PLUG OR BOTTOMING TYPES

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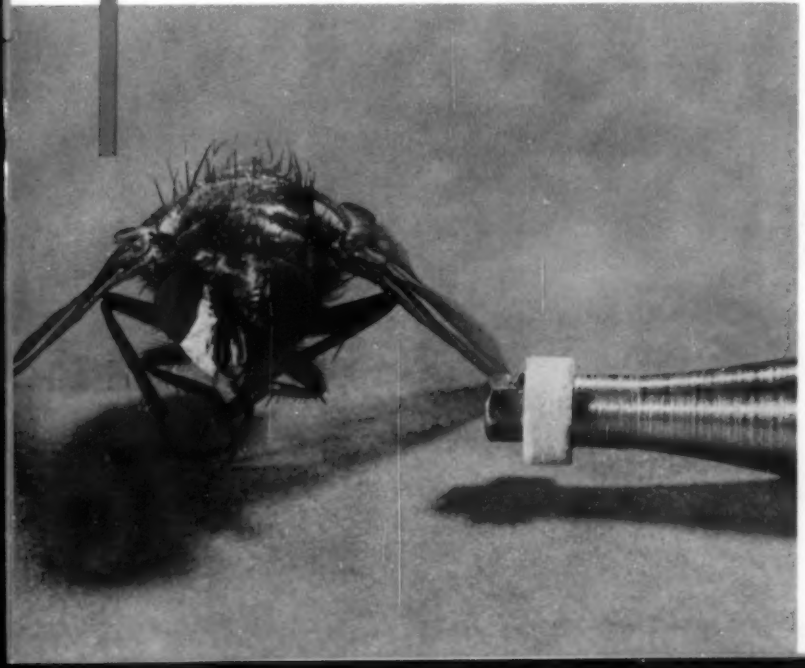
214

Progress Report on

BAY STATE

BAY STATE ®
WHEELS of PROGRESS

Bay State Reports:
AN IMPORTANT ADVANCE IN MICRO-MINIATURIZATION

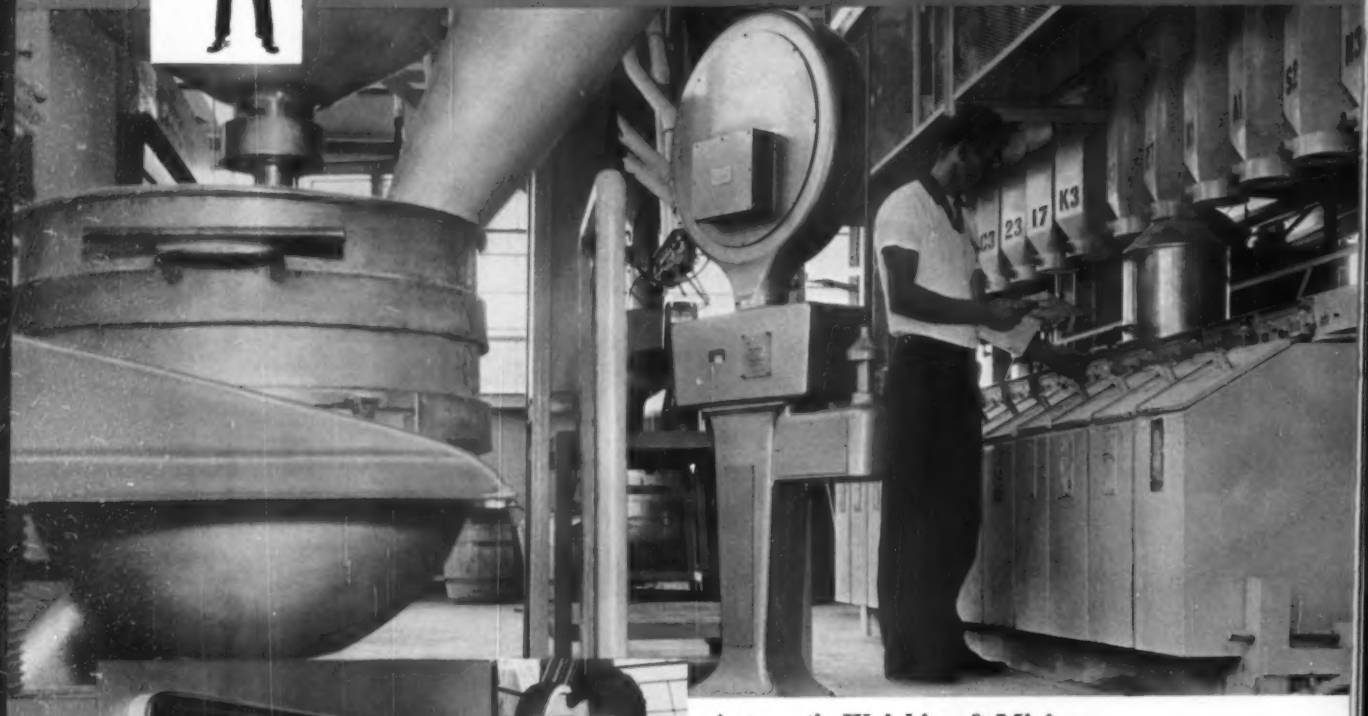


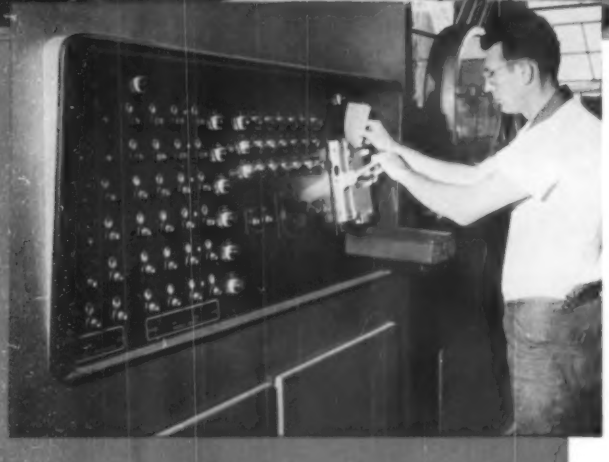
Tiny Grinding Wheels Developed for Delicate Tasks

Key feature in the development of this micro-miniature grinding wheel is its interchangeability. Previous ultra-small wheels had to be bonded permanently to a tool shaft. Bay State developed entirely new manufacturing techniques and produced true wheels which could withstand the strains set up when such a wheel is clamped to its shaft with a retaining nut. Special abrasive grit combinations were also developed to give superior finishes. In addition to substantially lower wheel costs, users have saved a considerable amount of set-up time during wheel changes in such operations as turning out micro-miniature ball-bearing races for high-speed cameras, tape recorders, missile guidance systems, etc.

On many larger diameter bores and races, Bay State's precision-mounted wheels, made in the conventional manner, continue in high demand due to their excellent performance.

Bay State Reports: OPTIMUM CONSISTENCY IN ABRASIVE PRODUCTS THROUGH INCREASED AUTOMATION





Automatic Weighing & Mixing

Weighing abrasive and bonding materials is a tricky business when it's done by hand. Yet consistent performance *depends* on accurate proportioning of all ingredients. That's why Bay State's ultra-modern automatic weighing and mixing equipment is such an important step forward in abrasive technology. Here, operator Richard Donovan (left) inserts a punched card in the control console which will make a completely automatic series of abrasive-grain weighing operations. Above, Donovan checks a bond-weighing cycle after setting it up on the console behind him. In the foreground is a high-speed mixer fed by chute from the automatic weighing equipment on the floor above. The accuracy and speed of this equipment enables Bay State to keep costs down and provide amazingly precise duplication of wheel specifications.

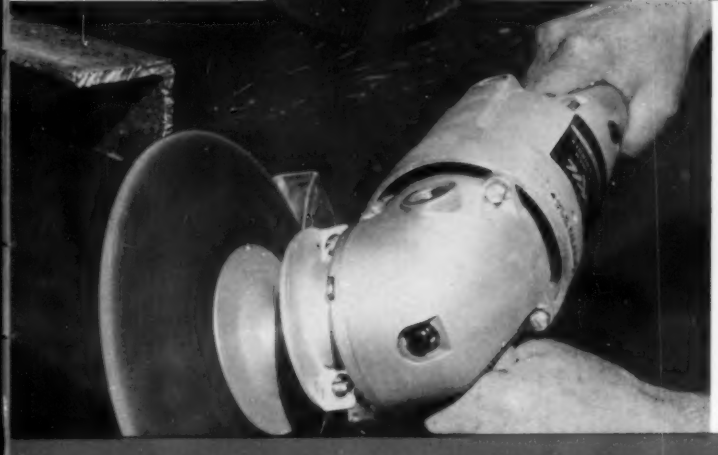
180 Feet of Controlled Super-Heat ▶

This is the ultimate in automatic kilns. Even the chemical composition of the atmosphere inside it is controlled by an exothermic gas generator which maintains exactly the atmosphere that best suits the formula of the honing stones and other abrasive products being fired. Electric heating elements provide constant, even heat (maximum is about 2350°F) without contaminating the atmosphere with unwanted by-products of combustion. Electronic controls are housed in a special air-conditioned room. Automatic feeding machinery delivers the abrasive products to powerful, hydraulic rams which give a 7000 lb. push and keep the production line moving through the kiln at a constant speed. Associate Laboratory Engineer Bill McMahon is shown here checking gauge readings.

Bay State Reports:

IMPROVED PERFORMANCE IN WELD-GRINDING THROUGH IMPROVED DESIGN

Bay State's new "Koolie Hat" portable grinding wheel cuts easier, safer and faster than any comparable wheel on the market. Its shape enables it to be held at a shallow (4° to 5°) angle so that operators work in a relaxed posture . . . are less prone to accidents caused by fatigue. The shape also ensures uniform wear on the periphery of the wheel so that thickness remains constant and only the wheel's diameter decreases . . . and the danger of shattering is virtually eliminated. Narrow radial contact area also ensures more uniformly high cutting speeds and prevents cracking due to heat build-up.



BAY STATE ®
WHEELS of PROGRESS

Bay State Reports: **BETTER SERVICE TO CUSTOMERS THROUGH PRE-PACKAGING**

Inventory control is greatly simplified for users and distributors, both, by pre-packaging of wheels in quantities that make logical units of supply for given types of grinding operations. Counting and handling time are reduced and such products as tool room, internal grinding, reinforced and mounted wheels can be supplied in their own protective packages. New packaging materials provide better protection than ever against dirt and breakage.

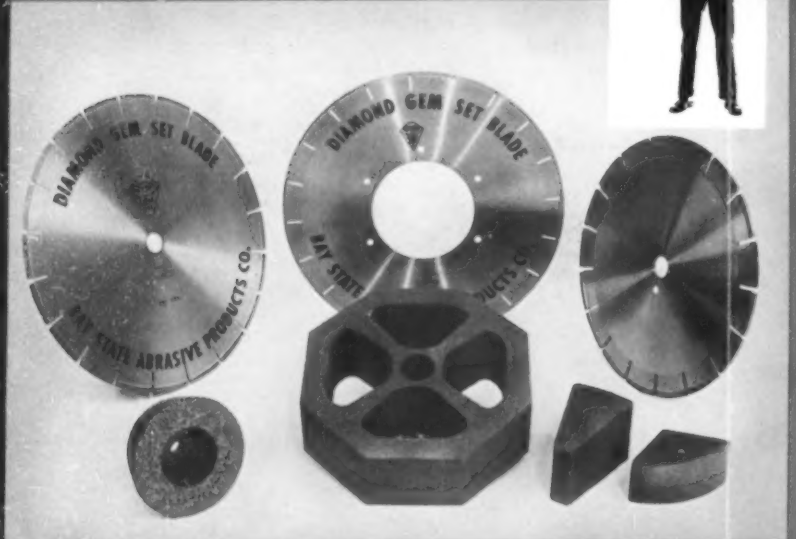
Bay State Reports:

ULTRA-THIN DICING AND WAFERING WHEELS FOR THE ELECTRONICS TRADE

These wheels are the real glamour queens of the abrasive industry. Their metal-bonded, diamond abrasive grit cuts through hard crystals of Quartz, Germanium and Silicon like a knife through well-aged cheddar. The wheels themselves are literally paper-thin (as thin as .006" to be exact!) so that they slice these valuable, electronic, semi-conductor materials with an absolute minimum of waste. Yet, these micro-thin blades are so rigid they cut with the utmost precision. Extra-deep diamond sections ensure maximum smoothness of finish and extra economy in terms of prolonged blade life. Bay State is now ideally situated to supply all of the great electronics manufacturing areas in the U. S.

Bay State Reports:

HIGH PERFORMANCE ABRASIVE PRODUCTS FOR THE STONE TRADE



There's nothing miniature about Bay State's diamond wheels for the stone trade. They're big, rugged brutes that slice through granite, marble, flagstone, quartzite and slate almost as easily as they do through sandstone, soapstone and the other softer minerals. Bay State also furnishes wheels and special shaped abrasive stones to fit all standard machines used for smoothing and finishing granite, marble and other types of stone. In each case Bay State develops the products for maximum cutting speed, precision and durability, resulting in the lowest cost per foot of cutting. Incidentally, with its greatly expanded diamond wheel facilities, Bay State is now one of the largest producers of diamond wheels in the abrasives industry.

BAY STATE
WHEELS of PROGRESS

BAY STATE ABRASIVES

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Chicago, Cleveland, Detroit, Los Angeles, Pittsburgh. *Distributors:* All principal cities.

SPOT NEWS...

- **Air Force plans to award a development contract for a new fighter-bomber** within the next six months. At least $25 million is earmarked for initial development. Plane is expected to be able to take off in 5000-6000 ft, operate off poorly developed air strips, and have intercontinental range without refueling.

- **Stainless-steel strip 27 in. wide can now be ground flat within 0.0005 in.** over the entire width. This joint development of Wallingford Steel Div of Allegheny-Ludlum and Behr-Manning Co is the result of an 8-yr program to apply wide-belt grinding to strip rolling mills. Up to now, fabricators had to use more expensive ground sheet.

- **Stretch-formed aluminum boat hulls will soon be in production** at Fairchild Aircraft, Hagerstown, Md, using a Reynolds Metals-developed process that forms the hull in two sections in minutes. Technique requires big aircraft presses and aircraft methods. Boats will range from 14 to 19 ft long in three sizes. Fairchild expects to be in mass production in two months.

- **Orders for machine tools in Britain reached $261.2 million** for the first seven months of 1960. This is 89% higher than in the comparable period of 1959, the low point of the British machine tool recession. Net new orders are on the rise but export orders are not expanding at the same rate as home orders.

- **Columbium alloy F-48 is now being welded and machined** by Ling-Temco Electronics, Inc, Dallas, Texas. Material retains usuable structural properties at temperatures up to 2500 F.

- **Program-controlled machine tools destined for export from Russia** are soon to go into production in factories in the Gorky region, reports Moscow. Observers recall that two members of the State Committee of Automation and Machine Building wrote in Izvestia a few months ago that only 60 program-controlled machine tools will be manufactured next year in all of the Soviet Union.

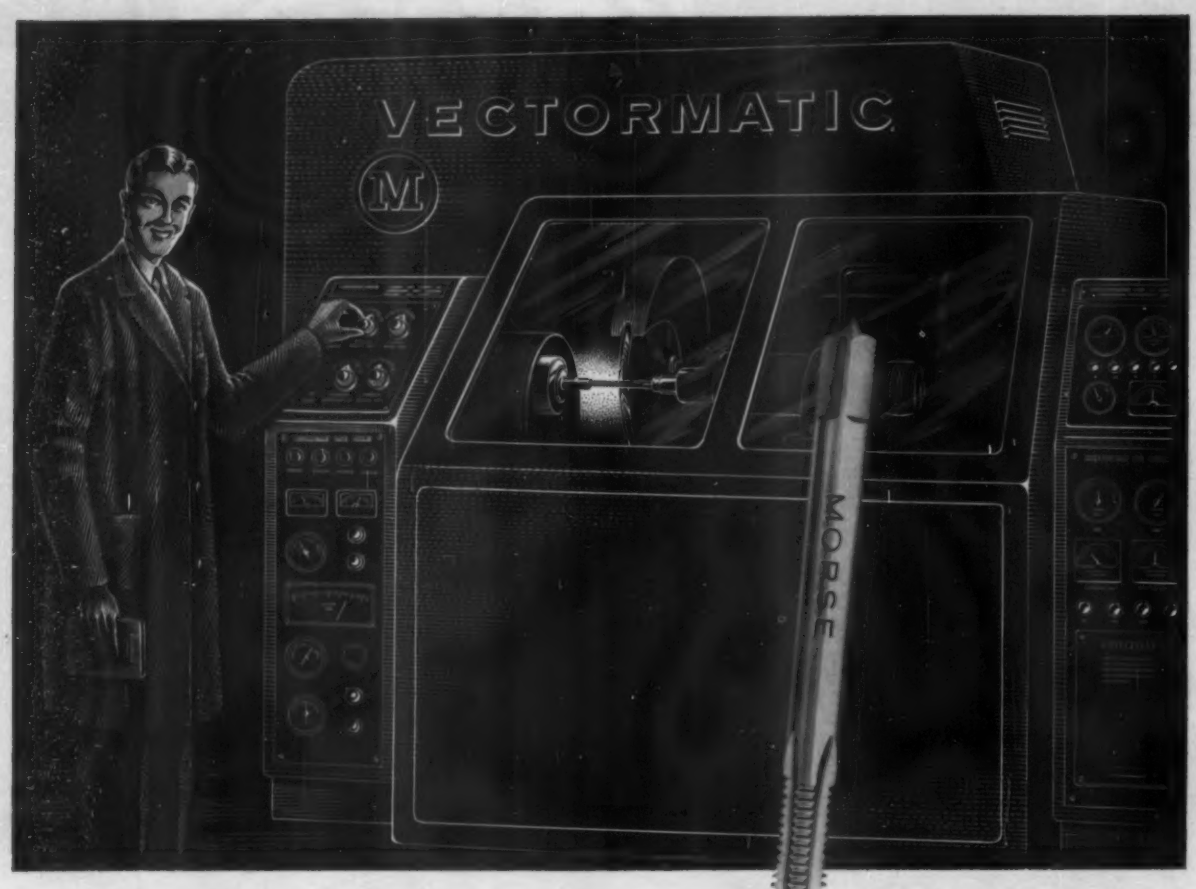
- **A new carbide for interrupted cutting** has been developed by Wickman Ltd, England. Wimet grade XL 35 has a grain structure that provides optimum resistance to flank wear and thermal cracking. Developed primarily for milling operations on steel, the new material has also proved effective in other applications.

- **Blast cleaning abrasive that lasts up to 2½ times as long** as malleable abrasives has been developed by Pangborn Corporation. Called Pangborn G, the material occupies a position between present malleable abrasives and steel both in performance and initial cost.

- **India hopes to increase its domestic machine-tool production seven-fold** by 1966, say Indian Government sources. From total of $9.45 million in 1959, India is aiming at $66 million production total. Hindustan Machine Tools Ltd proposes to double its present capacity to 2000 machines a year by 1966. Ex-Cell-O (India) Ltd will also boost production.

- **Sheetmetal turbine buckets have reduced the weight and halved the cost** of the small turbine wheel in fuel pump of GE's J93-3 jet engine. This is said to be the first application of sheetmetal buckets in turbine wheel design. High-temperature nickel-base alloy buckets replaced conventional cast-and-machined buckets.

MORSE AGAIN BRINGS YOU THE BIGGEST NEWS IN CUTTING TOOL HISTORY



First Patent of Its Kind Ever Issued For Tap-Manufacture

"Vectormatic" grinding – the revolutionary new principle of tap manufacturing is now an *exclusive Morse patented process.*

"Vectormatic" *automatically* and accurately controls grinding wheel feed limit and compensates for changes in the position of the cutting face of the wheel due to wheel dressing.

"Vectormatic" taps are *absolutely uniform,* with keen cutting edges that insure longer service life than any other tap on the market. For fast, economical, exact tolerance tapping, order "Vectormatic." Call your Morse Franchised Distributor today . . . your *only* source for patented Morse "Vectormatic" taps.

Patent No. 2929172 granted March 22, 1960.

2670

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WASHINGTON...

Deterrent strategy debate...

The long-range outlook for military hardware procurement is tied up in a sizzling inter-service controversy over deterrent strategy. At stake are decisions on the types and quantities of manned bombers, ICBMS, and other strategic weapon systems to be added to the U S retaliatory arsenal in the years ahead.

The debate has been under way behind the Pentagon's closed doors for years. Now it is coming out into the open as the Presidential election nears.

In brief, the policy squabble is over the size of nuclear striking forces this country must maintain to deter Soviet aggression. The Air Force wants an ever-growing strategic force which could knock out Russia's constantly increasing number of missile launchers and other defense facilities. Air Force theorists are confident U S missile and bomber forces could never be wiped out in one fierce blow. They're concerned, therefore, with our "second-strike" capability.

The Air Force's strategists hold that an all-out nuclear war does not necessarily involve city-busting or genocide. It is envisaged, instead, as a conflict in which offensive strikes are aimed at the enemy's sources of military power. Cities would suffer only what these theorists describe as "collateral" damage. So as the size of the enemy's offensive capacity increases, our own forces must grow. It all boils down to an ever-rising rate of military spending.

Army-Navy views...

Army and Navy theorists do not go along with the need to continue building up the size of our strategic force. They believe an all-out nuclear war is not likely because of its suicidal consequences, that brushfire wars are a greater threat, and that instead of building up a so-called "overkill" capacity—in heavy bombers and big missiles—we should be putting the money into stronger capabilities for fighting a limited war.

The theory here is that we need only enough nuclear striking power—preferably in mobile and invulnerable forces—to deter a Soviet attack. And "enough" in this view is the relatively static number of weapons to wipe out Soviet population centers.

No clearcut resolution likely...

The issue will be one of the key military questions dumped on the new administration. But it's not a question to be resolved with any hard and fast determinations.

Eisenhower administration policy, for example, has in theory reflected the Air Force or so-called "counter-force" strategy. But in fact, Pentagon insiders say, the administration's rigid restrictions on military spending have brought U S deterrent strategy more in line with Army-Navy views.

US overseas plants...

The Commerce Dept has put together the most definitive picture ever of how sales of American-owned overseas metalworking plants are growing in volume.

In 1959, sales of what the department calls "direct-investment enterprises abroad" in all types of manufacturing rose to $21 billion, $2.7 billion over 1957, the last year for which figures are available.

In machinery, the increase was from $1.9 billion to $2.2 billion; for electrical machinery plants, $2.05 billion to $2.06 billion; for transportation equipment, $4.2 billion to $5.3 billion.

One of the most significant conclusions of the new report: For most manufactured goods, production in U S-owned plants in Europe "far exceeded" imports from this country. Production by the plants for exports was "large" in the United Kingdom, Germany, Belgium, and Switzerland.

Growth of investment...

U S direct investment in machinery making plants overseas has grown from $420 million in 1950, to $927 million in 1957, to $1.2 billion in 1959.

Investment in transportation equipment plants totalled $1.6 billion in 1959, up $400 million from 1957; in electrical machinery, $834 million, a $103 million increase.

Heaviest machinery manufacturing investment is in Europe, $674 million in 1959, compared to $488 million two years before.

GNP to rise...

The Gross National Product (sum total of all U S goods and services) has held steady at an annual rate of about $505 billion in the second and third quarters of this year. But it is now expected that GNP will rise to a rate of $510- to $512-billion in the fourth quarter. The prediction is that of Budget Director Stans.

and now...

BULLARD DYNAMILL*

First fully Power-Controlled H.B.M.

Simple push button pendant controls and clock-type positioning dials accurately locate head, table, saddle, and spindle.

The Dynamill* H.B.M. uses Bullard's new Dynamic Precision Control System to increase productivity of the machine and quality of the work.

Dynamill* now brings the work and tool together in the shortest possible time.

These features on the new Bullard Dynamill* H.B.M. provide optimum productivity:

- **Simple push button pendant control**
- **Easy-to-read clock type positioning dials**
- **Four traverse rates including creep**
- **Infinitely variable feed rates which can be changed while the tool is in the cut.**

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Available in 3, 4 and 5 inch spindle sizes, four standard head post heights, five table sizes and five bed lengths.

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HI-LITE FEATURES OF THE DYNAMILL* H.B.M.

POWER CONTROLLED Simple pendant controls start, stop and speed of spindle as well as all directional movements of head, table, saddle and spindle. Large, easy to read clock-type dials show exact position of work in relation to tool. Infinitely variable feed rates and four traverse speed rates. Power Draw Bar for fast and easy tool change. Fully automatic hydraulic binders for head, table and saddle.

VERSATILE Saddle stops allow rapid traversing of saddle to pre-determined positions. Depth-Au-Trol* provides accurate spindle depth Control. Modified Mark 1 Tape Control for head and table positioning. Continuous feed facing attachments with infinitely variable feeds. Right-angle milling, thread cutting and contouring attachments. Built-in or auxiliary tables.

COMPACT AND RUGGED The new Bullard Dynamill* H.B.M. is compact in design — lower in overall height — requiring less floor space, yet has more built-in rigidity and durability.

EASY MAINTENANCE Automatic lubrication throughout — fewer parts — fewer adjustments — easily accessible.

"YOU CAN'T BEAT A BULLARD"

DETROIT...

Strong production...

Although the schedule may prove optimistic, automakers plan to build about 660,000 cars in October for an all-time record. September, too, achieved a respectable—for a changeover month—total of 410,000.

The local press read pessimism into Chrysler's surprise layoff of 5000 workers. Facts were that Chrysler in recent years never has had enough cars in dealer hands at announcement time. This year the goal was 150,000 units, and achievement meant that 5000 people were suddenly out of work.

The company wanted to do this on overtime, but union officials insisted on extra hiring. Another contributing factor was that Chrysler thought the railroad strike would be far more serious and long-lasting.

L'affaire Newberg (cont'd)...

An impressive 59-page legal document, dated October 3, 1960, and signed by Dewey, Ballantine, Bushby, Palmer & Wood, publicly absolved 36 top Chrysler Corporation executives of any suspicion of divided loyalty.

This "investigation of the investigators," with all of the prestige that the name Thomas E Dewey could give it, was instigated by nine non-management Chrysler directors who felt that a corporate-inspired police action might be subject to charges of whitewash.

Chrysler's troubles, it will be remembered, were first aired with the forced resignation on June 30 of President W C Newberg. Mr. Newberg was charged with profiting to the tune of $450,000 from his interests in Chrysler suppliers, and has agreed to reimburse this sum to his former employers.

Dewey and company found that "no instance of stock holdings by Chrysler executives in suppliers . . . involved any reasonable likelihood of affecting the executives' judgement in acting for Chrysler." Nor did any instance involve "any similarity to those which have been held in decided cases to represent a forbidden adverse interest."

These 36 Chrysler executives, all members of the Operating Committee, were subjected to an unprecedented invasion of what is normally construed to be a man's private business. They were forced to submit personal bank, brokerage and income-tax records for a ten-year period. Even rumors concerning their outside activities were checked out by skilled private investigators.

Close observers of the industry feel that the Dewey report, aside from clearing 36 individuals of suspicion of malfeasance, has for the first time documented a guide to what constitutes a conflict of interest.

Prices hold...

Automakers, secure in their belief that steel will hold the line, have posted prices that are fundamentally unchanged from the last model year.

There were even some surprises: Valiant was cut $19 to $36 to allow room for the new compact Lancer, which costs approximately that much more. Buick surprised everyone by pricing its new compact Special in the $2175-$2425 range, thus jumping solidly into what used to be the low-priced field. Pontiac's Tempest is $200 less.

Mercury, entering the low-priced field and the burgeoning six-cylinder market for the first time, has a two-door model tagged at $2201. This price is $188 under the lowest '60 price.

New look in service...

1961 will go down in automotive history as a blue year for the service station business. Almost every maker has an innovation designed to keep your car on the road and out of the garage.

Cadillac, for example, is lubricated for life. Many Ford products do not need greasing until after 30,000 miles. All makes have followed Ford's lead by extending their guarantees to 12,000 miles and/or one year.

Oil-change interval is constantly edging upwards, Lincoln being the current leader with a recommendation of every 6000 miles. Transmissions and differentials on some makes are sealed for life.

American Motors has introduced a ceramic-coated muffler and tailpipe that is flatly guaranteed for the life of the car. Other makes have "aluminized" these parts and claim three times longer life.

There are batteries on the market that are guaranteed for five years and need checking only twice a year. Antifreezes have been introduced that are expected to last at least two years.

All of this may seem of only indirect interest to the machine-tool industry. However, the service station (not garage) of the immediate future may not need hydraulic hoists. Because the hood need not be opened every time gas is purchased, there will be less opportunity for service stations to merchandise parts and accessories. In other words, doldrums can be contagious.

—Don MacDonald

Now . . . 3½" Capacity With This New Greenlee

Biggest of the Greenlee Bar Automatics! This new 3½"— 6 spindle model offers the most outstanding advantages in the field. It is exceptionally versatile. It offers well-known Greenlee dependability. Like all Greenlee Automatics it has independent, cam-operated cross slides and a wide-open tooling area. Greater flexibility, accuracy and productivity are built into this big, powerful Greenlee Automatic. Check these outstanding advantages:

- Permanently Aligned Spindle Carrier
- Positive, High-Speed Carrier Indexing
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- Sturdy, Cam-Feed Main Tool Slide
- Interchangeable Cross Slide Camming
- Micrometer Adjustment On All Cross Slides
- Rapid-Shift, Dual-Range Speed and Feed Gears
- Built-in Lead Screw Threading Feed and Drive

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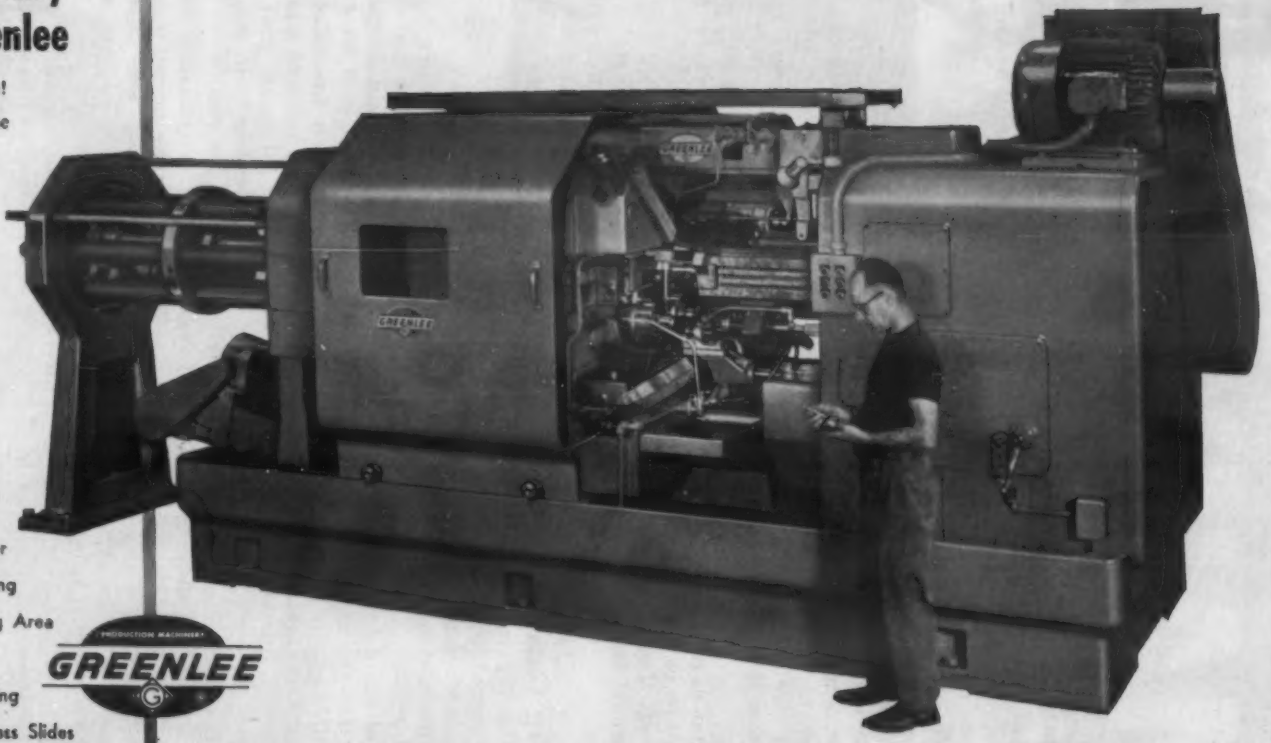

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Other Greenlee 6 Spindle Bar Automatics are offered in 1", 1⅝", 2" and 2⅝" capacities.

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AIRCRAFT and MISSILES... TRENDS

Aircraft firms diversifying...

Names long associated with the aircraft industry appear more and more frequently today in connection with non-aircraft business.

For example, Ling-Temco Electronics, the firm that grew out of last summer's merger between Ling-Altec Electronics and Temco Aircraft, will definitely emphasize electronics in its future sales plans.

In three to five years, the firm hopes to have its electronics business split 60% military, 40% non-military. The Temco Electronics and Missiles Division, however, will continue to stress the missile and space market.

Martin-Baltimore Electronics Division is also expanding its non-defense work, but expects that defense contracts will continue to dominate the workload.

Machine-tool control is one of the Electronics Division's major targets. Engineers are working on data processing research aimed at increasing versatility of machines so that low-quantity production runs can be handled economically with automatic control.

One possibility is to use a single data processor to feed information on different tasks to a series of groups of machines in sequence.

Diversification, however, is not a cure-all. Just about a year ago Chance Vought, faced with a decline in its aircraft business, became a major producer of mobile homes. C-V acquired three producing companies whose 1959 combined sales totaled some $60 million. In the first half of this year, sales amounted to under $3 million for Vought Industries, the mobile-home subsidiary.

In addition, earnings of the parent company for the first half of 1960 were less than half of last year's mid-year figure.

Celanese enters missile field...

The Ashville, N C, rocket plant originally set up by Oerlikon Tool and Arms Corp of America (part of Oerlikon Machine Tool Works) about nine years ago, has been taken over by Celanese Corp of America.

To be known as Amcel Propulsion, Inc, the Celanese subsidiary will concentrate upon development of rocket propellants and will also make related items. At a later date the company may go into development and production of small tactical weapons.

NASA eases contractors' fears...

The National Aeronautics and Space Administration told contractors that it plans to rely heavily on industry participation in Saturn and other programs at its Marshall Space Flight Center. Contractors feared that NASA would do most of the work itself.

Major prize, should test program be successful, will be the multi-million dollar airframe production and vehicle assembly contract for the Saturn booster. Specifications for the C-2 second stage are now being drawn up, and industry will be asked to bid on the 200,000-lb-thrust engine sometime next spring.

Space Age machine tools...

Convair has just taken a long look (at the request of the Aerospace Industries Association) at the ability of today's machine tools to cope with Space Age machining problems.

Much of today's manufacturing equipment, Convair researchers find, just can't do the job, and aircraft and missile firms are forced to modify existing equipment drastically, or even build completely new home made machines.

Exceptions to the general inadequacy are numerically controlled machine tools. According to Convair investigators, these machines have proved highly successful. Only trouble is that there are still too few of them in the industry.

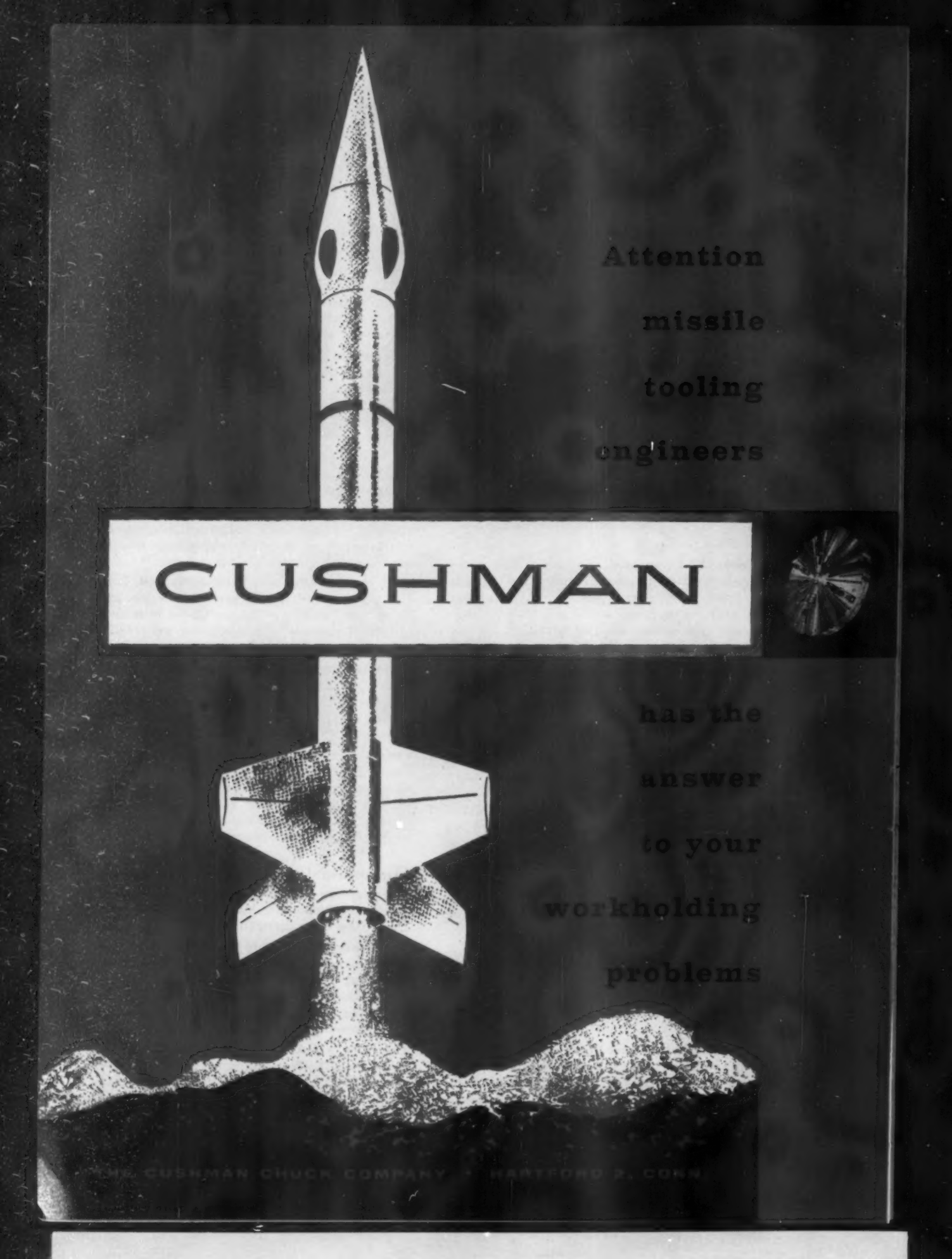
Convair's recommendations (details on p 101): Integrally designed controls, counterbalancing of all moving parts, backlash eliminators, nonfriction bearings, greater rigidity and stability, more efficient chip disposal, preplanning for the addition of vacuum systems.

Commercial use of AF facilities...

The question of commercial use of military-owned production facilities by a defense contractor has come up again.

The General Accounting Office reports to Congress on a case involving Avco Corporation's Lycoming Division. The company is charged with using USAF-owned production equipment during 1953-55 at a rental rate lower than the rate allowed by the contract.

Following a GAO probe into the case, USAF collected $216,800 in additional rents from Avco and clarified its rental policy for the company—payment is required on the basis of the time the facilities are available for use, rather than on the former basis of actual use.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MACHINE TOOLS...

Machine tool sales looking up . . .

The Machine Tool Exposition already has sparked a modest amount of buying and promises to generate an increased volume of new orders during the fourth quarter. Inquiries stemming directly from the show are heavy. The quality is very good and most of the inquiries do not come from prospective customers who were "just looking around."

This is the consensus of opinion among machine tool builders and distributors as a result of a spot check round the country. Cautious optimism prevails. Though September was reported to be a considerably better month than August for orders, and predictions are for a gain of 10-20% in the October-December quarter, no boom is in prospect.

Warner & Swasey backlog soars . . .

Warner & Swasey calls the Exposition "an unqualified success." It booked more new orders for machine tools in September than in previous four-and-a-half months. Its backlog has gone from 60 days to 6 months, with good shipments assured through the first quarter of 1961.

September sales confirmed the fact that more orders had been held up pending the show than the company had anticipated. Many of September's orders admittedly were closed because of a price increase that allowed customers to convert outstanding quotations at old prices into firm orders up to September 23. Nevertheless, Warner & Swasey feels that fourth quarter sales at new prices will be good.

Keen interest in tape control . . .

A number of builders feel that much of their business the next six months will come from tape-controlled machines in which customers have shown keen interest. A prominent distributor reports lively and tangible inquiries for numerically controlled machines.

Several special machine tool builders point to pending automotive buying plans as a source of business before the end of the year, possibly in November. At least one transfer machine builder had a substantial sales pickup in September, deriving much of its new business from abroad.

Detroit buys presses . . .

A leading press builder already has received a sizable volume of orders in October and the entire fourth quarter looks bright. Its optimism is based on a revival of buying at Detroit and on continued demand from foreign automobile manufacturers.

Here is a summary of reports from individual builders of cutting-type machines:

- Builder No. 1—60% of its machines at the show have been sold. Its September dollar volume of orders was up 30% above August. It views the fourth quarter with modest optimism.
- Builder No. 2—Inquiries up considerably during and since the show. September sales were 20% better than August's which were slow. Fourth quarter should just about hold even with September.
- Builders No. 3—Sales of standard machines held steady in September and demand for "specials" increased notably. Rest of year looks good for pickup in all classes of tools.
- Builder No. 4—September was 50% above August which was a stinker. Fourth quarter will do well to keep up to September level. Lots of active inquiries but do not expect to convert many to sales until '61.
- Builder No. 5—Lots of firm quotations are being made. Caliber of show visitors was very high and much of the interest in its machines has come from industry in general rather than from specialized customers.
- Builder No. 6—September orders were 25% better than those in August. Fourth quarter business should be good. Now is poor time to raise prices, but may have to soon as result of higher costs.

Fourth quarter prospects good . . .

Distributors of cutting-type machines have these comments on the show and the outlook:

- No. 1—Our area was dead pre-show but now there are numerous good inquiries. Fourth quarter prospects have improved.
- No. 2—We have sold two machines totaling $55,000 as result of show. Fourth quarter should be up 15%.
- No. 3—Show provided definite stimulus, and expect fourth quarter to be 50% above 1959.
- No. 4—Fourth quarter promises to be up 20% over '59. Number of customers from our area at Chicago was beyond our fondest hopes. Feel that $15,000 we invested in our attendance at show will pay off in six months to a year.
- No. 5—Show was shot in the arm needed by the industry. Fourth quarter looks promising.

WIDEST SELECTION—You choose from the nation's largest and most diversified alloy steel stocks at Ryerson—available to meet even your largest requirements.

8-STEP CERTIFICATION—Our unique 8-Step Certified Alloy Plan assures test-proven quality and predictable performance every time . . . guides heat-treatment . . . cuts reject loss.

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Hot rolled and cold finished

Low Carbon Case Hardening	4615/20
	E8615
	8620
	8620 leaded
	E9310
	Nitralloy
	135 modified
Heat-Treated Medium Carbon	4140
	4140 TG & P
	4140 leaded
	4147/50 leaded
	4340
	Rycrome®
	Rycrome TG & P
	Nikrome®
	Nitralloy
Medium Carbon Annealed Direct Hardening	4140
	4140 leaded
	4147
	4147/50 leaded
	4340
	E6150
	8647 leaded
Rycut Free Machining	Rycut® 20
	Rycut 40 and 50 annealed
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MATERIALS...

Return of titanium? . . .

More than a year ago the US Air Force dropped most of its support of research in fabricating titanium aircraft. Now, Convair manufacturing engineers tell us that the B-70 may be the last to use stainless steel; that aircraft thereafter will have to go to titanium or "something better." Right now, they don't know of anything better—and look toward a big pickup in titanium applications in the relatively near future.

Steel-tough glass . . .

Glass can be given more bend strength than is present in plain carbon steel by a process developed in the USSR. Conventional sheet glass (no composition given) is softened at a temperature of 390 F before being plunged into a hot processing bath of liquid organo-silicones. Finally, the glass is tempered by cooling the bath in accurately controlled stages of 70 F each.

Bend strength of ⅛-in.-thick glass sheet is said to be increased at least 11 times by this process. Thicker glass shows an even greater increase.

A US development called "Nucerite," by the Pfaudler Co, a division of Pfaudler Permutit, Inc, is testing out at strengths higher than those of structural steel. Nucerite is a composite of a unique crystallized glass bonded to a metal base. The combination is exceptionally tough and has "great" temperature resistance. Pfaudler expects its greatest values will be found in chemical, nuclear, and space equipment.

Differential zinc coating . . .

A corrosion-resistant, hot-dip zinc coating on one surface and a smooth spangle-free finish on the opposite side characterize a differentially galvanized sheet developed by Armco Steel Corp, Middletown, Ohio. An excellent base for high-lustre body finishes is provided by the smooth side. Designated Armco Zincgrip DC, the sheet combines paintability with good spot welding characteristics plus corrosion resistance where it is needed. Compatible with phosphate paint bonding systems used in the automotive industry on cold-rolled steel, this zinc coating requires no special preparation. Both cold-rolled steel and Zincgrip DC can be treated for painting at one time.

Iron-making—home style . . .

Perhaps it won't happen in our lifetime, but the giant blast furnaces that have contributed so much iron to our economic growth seem doomed to eventual obsolescence. A modern blast furnace and coke plant requires an investment of about $90 per net ton of annual capacity. Research teams all over the world are seeking simpler, less costly techniques for producing iron. Several practical methods have been developed, mostly involving direct chemical reduction of one.

Practical application . . .

Most recent pig-iron-making process to be revealed is said to require an investment of $35 to $45 per net ton. Or, a single-unit plant capable of producing about 500 tons of pig iron per day would cost between $6 and $7 million. Described as the D-LM Process, the research which evolved it was begun in 1948 when McWane Cast Iron Pipe Co, Birmingham, Ala, sponsored a program at Battelle Memorial Institute. McWane's ambition was to develop a practical on-site source of pig iron for its own needs. Three companies, Dwight, Lloyd, and McWane contributed to the development of the process. Since 1956 the work has been conducted at the McDowell Co's research facilities at Cleveland. On Lake Erie, where electric power costs eight mils per kwh, D-LM iron can be produced for $47 per ton. Estimated cost in Birmingham is somewhat lower.

In operation, fine iron ore is mixed with coal and limestone, pelletized and fed to a sintering machine. Partial reduction is accomplished by sintering. Self-fluxing, self-reducing pellets are discharged from the sintering furnace, at 1500 F, to the electric furnace for final smelting. Drying, heating, calcining, and pre-reduction in the sintering machine are completed in only 10 minutes.

Raw materials for the process include ore and limestone screenings, and non-coking quality coal.

New look in tubing . . .

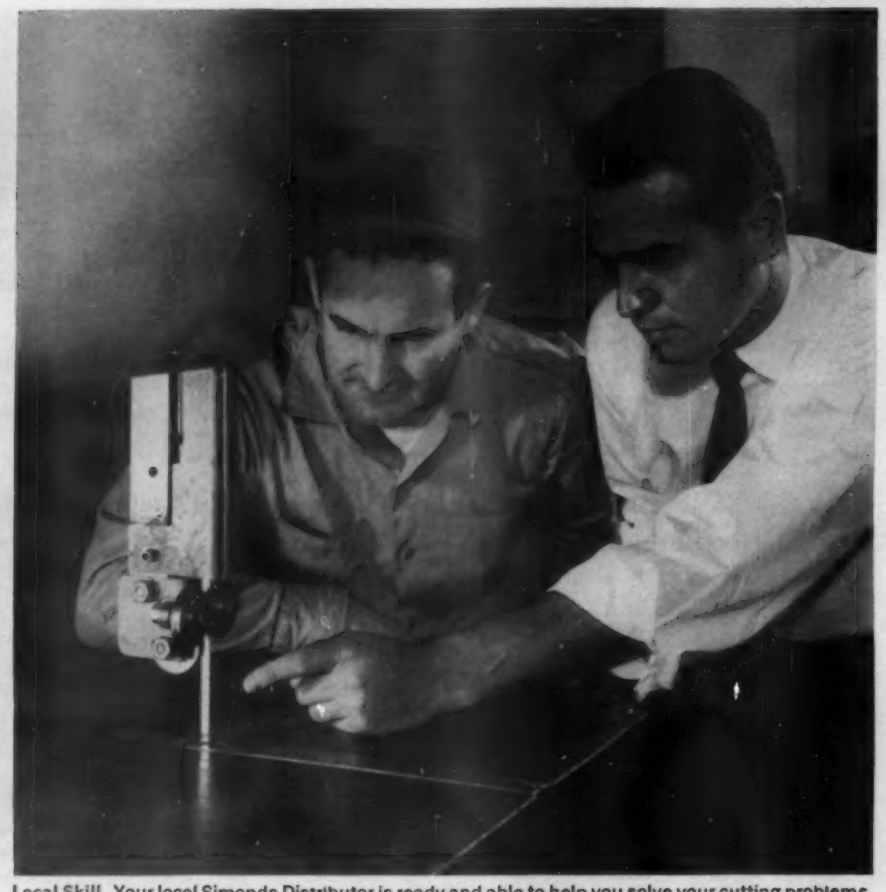
Tubing produced by the unique cold-working method developed at Damascus Tube Co on a modified Cincinnati Milling Machine Co Intraform machine has a variety of unusual characteristics. In addition to extremely close wall and diameter tolerances, internal configurations can be extremely varied, including ribs, spiral fins, and hollow walls. Stainless steel, Hastelloy, Zircaloy, tantalum, and titanium are among the metals formed so far.

Simonds offers you 3 TYPES of Metal Cutting Band Saws:

SUPER High Speed Steel . . . an entirely new concept in band saws, this super blade will give up to 3 times better performance than any other high speed steel blade.

Standard High Speed Steel . . . a tool of highest quality, designed for faster cutting and longer life than conventional metal cutting band saw blades.

Hard Edge Carbon Steel . . . a top quality blade well known for its versatility. Furnished in all standard widths and tooth styles for contour or cut-off work.



Local Skill. Your local Simonds Distributor is ready and able to help you solve your cutting problems. He's always "on call" for emergency service or engineering help.

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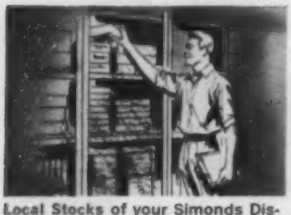

Local Stocks of your Simonds Distributor mean less money you have to tie up in inventory, and big savings in stockroom space.

Local Speed of your Simonds Distributor means fast delivery. Greater convenience, too, with one order, one invoice, one check covering many different items.

Back of the "controlled conditions" quality of every Simonds cutting tool is the "Triple-S-Service" of your local Simonds Distributor. He not only *stocks* and services your account with local *speed*, but provides a local source of technical *skill* and know-how.

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WHAT'S AHEAD... in Metalworking

TRENDS

Metalworking production starts to climb . . .

Business is picking up slightly, report most metalworking firms, but the increase is a very modest one.

Steel production is rising slowly in several major producing areas, mainly because of a continued pickup in automotive ordering. But the sharp upturn that has been predicted every month has now been pushed ahead to November. Some producers are anticipating a rise of as much as 15 points in the operating rate in November.

Major producers of automotive parts are reporting spotty business. Ordering from Detroit continues for the most part on a hand-to-mouth basis. One major producer says his passenger car parts business is operating above normal levels, and predict a fourth-quarter production gain of about 10%.

Sales of automotive replacement parts are just about holding even with 1959. Increases in export sales, says one producer, may put his company over 1959 levels, but the increase is not expected to be very large.

Foundry operations picked up somewhat, but the feeling is that the pickup can be attributed to seasonal influences. Foundrymen anticipate that 1960 business will slide along at levels lower than those of a year ago. One spokesman states that the appliance industry could be the bright spot for his company in fourth quarter.

Industrial fastener manufacturers report some light improvement, but admit that it was nothing startling. Production continues at slightly lower-than-normal levels, and outlook for the year pegs production and sales at about 1959 levels.

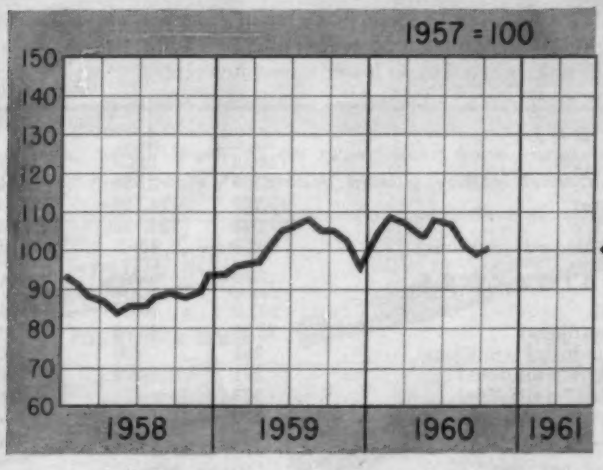
Production of major home appliances shows signs of turning up, but most of the big producers report business off from last year. Inventories are still heavy. Prices are firm now but fluctuate with changes in steel prices.

Sales of industrial materials handling equipment dropped 33 points in the latest monthly bookings index of the Materials Handling Institute. The index now stands at 126.79, using 1954 = 100. This sharp drop follows two months of rising business.

Industrial heating equipment manufacturers report that ultra-high-temperature units and vacuum equipment are in demand. Several major furnace builders report business running about 10-15% ahead of 1959, but the Industrial Heating Equipment Association reports that business for the first eight months of 1960 is down about 14% from last year.

Bearings manufacturers report production levels of anywhere from 60 to 80% of capacity, with the expectation that business will continue at this pace for the rest of the year. One large manufacturer foresees 1960 domestic business off 10 to 11% from 1959, and predicts that domestic business in 1961 will be 14% lower than 1960 levels.

Several machine tool builders are expecting that the auto firms will finally break loose some of the programs they've been holding back. The break may come as early as November.



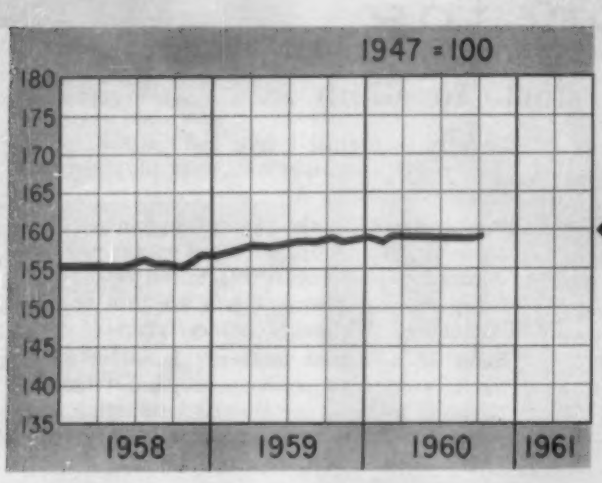
100

AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	SEPT Estimated	AUG Preliminary	JULY Revised	AUG Year Ago
Total Index	**100**	**99**	**101**	**105**
Machinery	99	102	103
Electrical Machinery	108	102	112
Autos	83	102	106
Other Transportation	87	87	96
Other Metalworking	111	107	96

TRENDS WHAT'S AHEAD... in Business



159.8

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	SEPT Estimated	AUG Preliminary	JULY Revised	AUG Year Ago
Total Index	**159.8**	**159.4**	**159.4**	**159.4**
Metalworking Machinery	**192.4**	**192.4**	**187.8**	
Other Machinery exc. Electrical	**172.8**	**172.6**	**171.3**	
Electrical Machinery	**159.4**	**159.6**	**162.2**	
Fabricated Metal Products	**147.6**	**147.6**	**148.5**	

A look behind unemployment figures...

Unemployment figures in recent months have come in for renewed attention. And this is demonstrated by platforms of both political parties, which vow aid to areas hardest hit by unemployment.

Back of this interest in unemployment is the relatively high level of joblessness we've seen despite generally good business. At its peak this summer, unemployment hit almost 6% of the labor force.

Joblessness has risen largely because of two interelated reasons: innovation and the rapid increase in our youthful population.

New technology demands greater knowledge, skill, and mobility than ever before. Yet these qualities are precisely what many of our unemployed lack.

Teenagers particularly are short on the skills currently required by industry. Nevertheless, this year almost 2 million 14 to 19 year olds came into the labor force looking for full-time jobs. And this number will be increasing in the years ahead.

In addition, industrial migration and technological innovations have created pools of unemployed in some areas of the country. In these locales many of the jobless are older workers whose skills can't be adapted to new industries.

Actually, though, these older workers and teenagers account for only about half of our unemployed. And they are the hard core of our unemployment.

Most of the remaining unemployed are out of work because of seasonal factors, or because they've quit work voluntarily in order to find better jobs. Among mature workers—those aged 24 to 64—the unemployment rate is considerably lower than that for the country as a whole. Only about 4% of this group is without work.

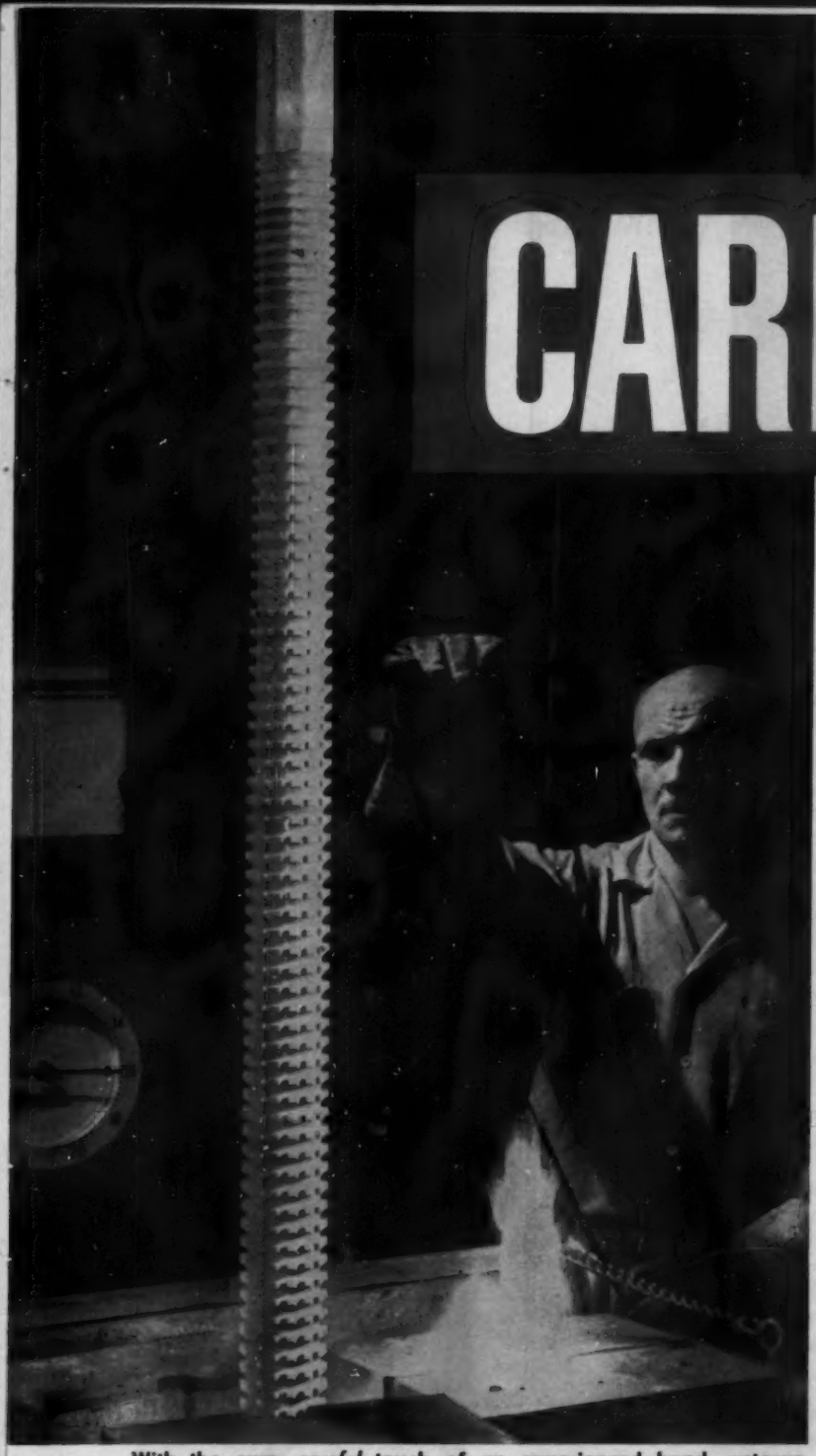
But it's clear that greater emphasis on education and training to meet the needs of new industries is a key to lower unemployment.

WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	149.2	148.2	145.6
Steel ingot operations (thousands of tons)	1,500	1,558	362
Electric power output (million Kilowatt hours)	13,779	14,156	13,234
Production of automobiles and trucks	137,023	120,722	105,720
Engineering construction awards (Eng. News-Record—millions)	602.8	409.5	241.5

QUARTERLY BUSINESS INDICATORS	Latest Quarter	Preceding Quarter	Year Ago
Gross National Product (billions)	505.0	501.3	489.9
Expenditures of new plant and equipment (millions)	36.30	35.15	32.50
Profits after taxes in primary iron and steel industry (millions)	263	400	552
Profits after taxes electrical machinery industry (millions)	261	264	296
Profits after taxes machinery (except electrical) (millions)	323	271	400
Profits after taxes in motor vehicles and parts industry (millions)	504	565	596
Motors and generators new orders index (1947-1949=100)	180	169	186

*Seasonally adjusted

CAREFUL!



With the sure, *careful* touch of an experienced hand, veteran CTW heat-treat man hoists 72" broach from a vertical furnace.

Care in the creation of Continental Broaches takes precision manufacturing a step beyond the exactness of quality control. Thirty years of broachmaking—designing and producing thousands of standard and custom-made broaches—assures *unmatched* efficiency and performance from CTW Broaches.

Find out how Continental's experience in broach engineering, modern heat treat methods and cost-saving production processes can cut downtime and increase output in your operation. Call your local Ex-Cell-O representative, or contact Ex-Cell-O Detroit; in Canada, Colonial Tool Co., Ltd., Windsor.

39-14

CTW Continental TOOL WORKS

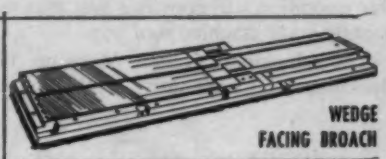
DIVISION OF

EX-CELL-O CORPORATION

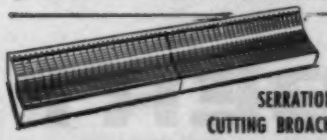
DETROIT 32, MICHIGAN

PINETREE FORM BROACH

SPIRAL SPLINE BROACH

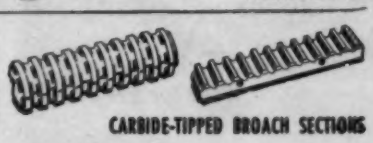


WEDGE FACING BROACH



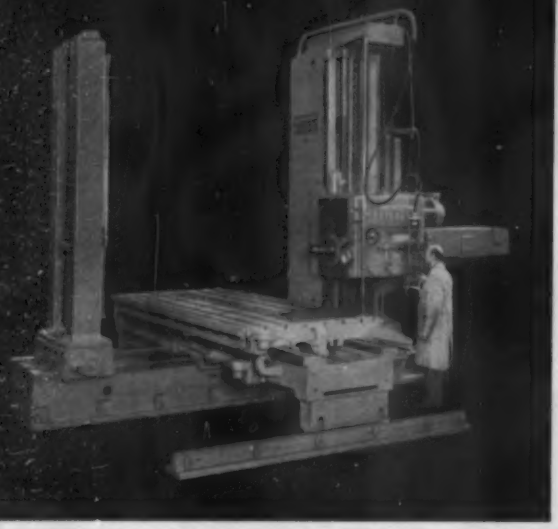
SERRATION CUTTING BROACH

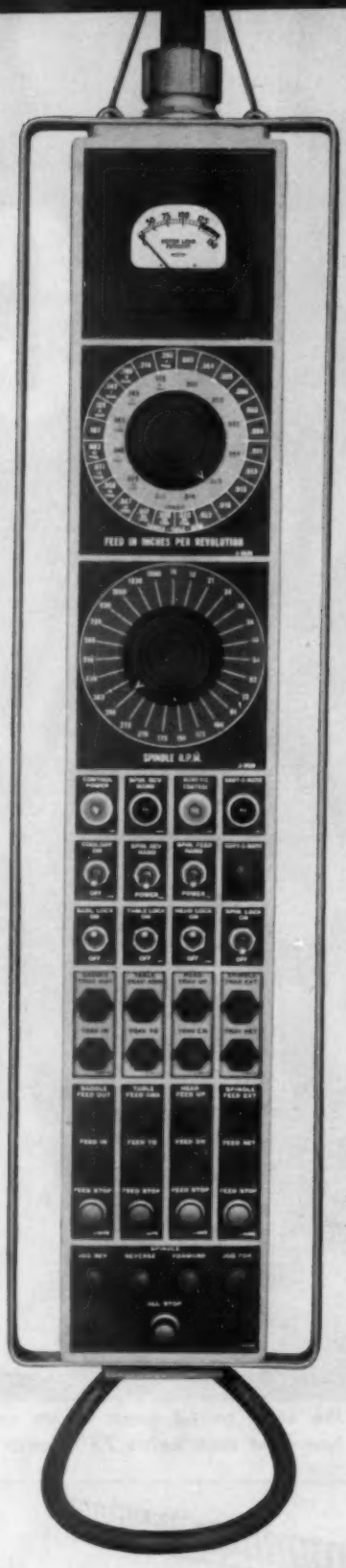
INVOLUTE SPLINE SHELL-TYPE BROACH



CARBIDE-TIPPED BROACH SECTIONS

CIRCLE 239 READER SERVICE CARD





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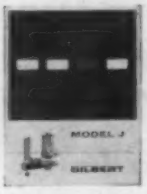


GILBERT

American Machinist / Metalworking Manufacturing ESTABLISHED 1877

What Automation Can Do For You

Automation is still a glamor word often tossed indiscriminately off the tongues of a lot of people, including politicians and unionists.

From these careless and generalized references to it, the impression is that automation, like some mechanical monster beyond human control, is about to overwhelm us. An examination of the situation in the metalworking industries, however, gives no support whatsoever to such a fantastic concept.

The truth is that automation . . .

at first became a fad. Some managements got caught up by it and found out to their disappointment that it did not do for them what they thought it would in lowering costs. Since then, automation has been accepted more and more for what it is. And it has been making quiet, solid gains in metalworking shops.

Proof of these gains is found in a recent survey made by the editors of AMERICAN MACHINIST/METALWORKING MANUFACTURING showing that around 24% of the companies responding have some automated equipment at work in their plants. That compares with 19% in a similar survey three years ago.

But that is only part . . .

of the story. More than half of the plants with 500 to 999 employees have automated equipment, against 35% in 1957. And shops with fewer than 500 employees are increasing their automation. This means that automation is not being confined to mass-production plants.

Popular concept of automation is of an entire manufacturing plant denuded of men. While admittedly such plants are in existence, they are the exception rather than the rule. Average application of automation is far less dramatic than that.

It assumes the form of automatic loading and unloading of machine tools and presses and of transfer devices between machines. It includes automatic lines for painting, plating, heat treating, welding, brazing and forging. It embraces in-process automatic gaging and automatic in-process storage units.

There are practical reasons why automation, in the forms just enumerated, is being used more and more. An overwhelming majority of companies with automated equipment say that they have installed it to reduce their direct-labor costs. At the same time they acknowledge that increase of output is another major objective. And 39% of the companies admitted that they have invested in automated machinery to improve the quality of their product.

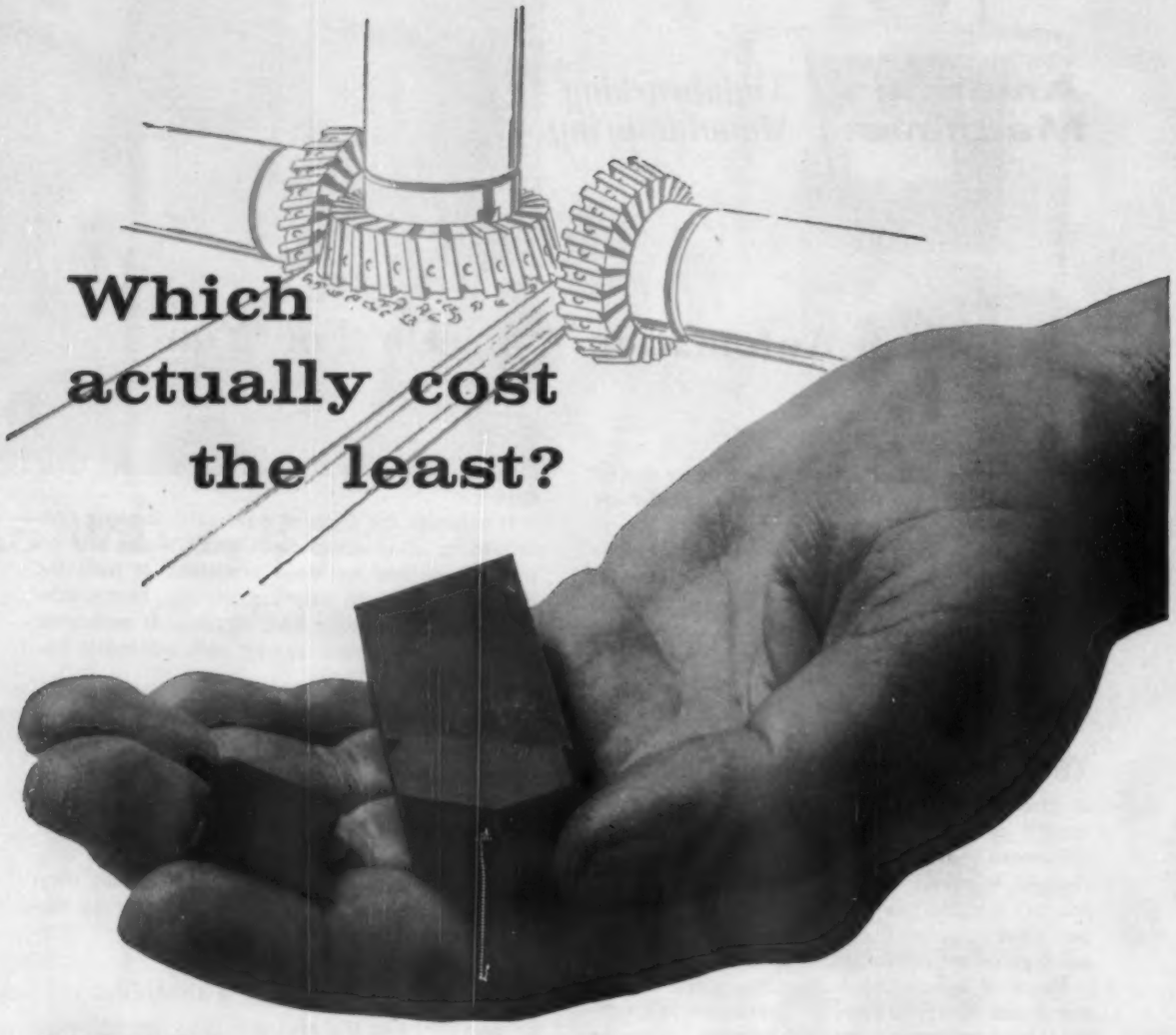
So automation is not a matter . . .

to be viewed in the abstract. Only the ignorant or those with special interests to push will condemn it sweepingly or look upon it with alarm and advocate its close control by a combination of government, management and unionists.

Its possible applications are myriad in number. Each one should be examined carefully on its own merit and adopted or discarded. It can do much to improve efficiency, enhance product quality and lower costs when installed in the right places.

It is management's responsibility to keep abreast of the many improvements constantly being made in automation and to put those improvements to work in its own shops wherever it is profitable. Only with this sort of constant vigilance will Metalworking be able to make maximum use of it.

Burnham Finney EDITOR



Which actually cost the least?

LOOK TO INGERSOLL FOR THE ANSWER

There's a place for each. Some say the throw-away offers the lowest-cost edge. Others prefer the tipped blade for the same reason. Both are in general use.

Analysis of work to be done, of the machine assigned to the job, and of the cutter itself will determine what blade is best. That's why many firms rely on Ingersoll's help in arriving at economical solutions to cutter problems.

For efficient, low-cost metal removal, let an Ingersoll representative make a preliminary survey. It will cost you nothing . . . may lead to important savings. Ask a representative to call, or write for the booklet, "Ways to Reduce the Cost of Chips." Address Dept. K-68.

THE **INGERSOLL** MILLING MACHINE COMPANY **CUTTER DIVISION** ROCKFORD, ILLINOIS

Researchers look into machine tool capabilities for aerospace output, urge . . .

Let's catch up with the Space Age!

By John R Condit
Facilities equipment engineer
Convair
A Division of General Dynamics Corp
San Diego, Calif

Only a small percentage of today's machine tools can cope with machining demands of the aircraft and missile industry in the coming years—and most of these are numerically controlled units developed in the last decade.

This is not mere opinion. It is the finding of an extensive survey conducted by Convair-San Diego for the Aerospace Industries Association of America. Object: to find out if existing machine tools can meet exacting standards for producing increasingly complex parts from "exotic" materials.

Convair's equipment engineers, assigned the survey job, dug back into their records and came up with evidence of the costly and unmistakable inadequacy of much of today's manufacturing equipment.

For example, it frequently takes three to six months to integrate a new machine into production—modifying, reworking, debugging and adding or incorporating special features to meet aircraft and missile demands.

Home-made tooling

Visit any major aircraft or missile plant in the country and you will find milling, drilling, turning, forming, welding and other machines which are the products of their respective tooling departments. These "home made" machines are designed, engineered and built to perform tasks beyond the capability of any machine tool on the market.

These machines—whether they appear in the shop tagged as tooling manufacturing aids, special equipment, or whatever—are highly specialized and cannot be replaced by any standard tool available. Yet their number could be greatly reduced if standard tools would be put on the market with improvements and refinements in keeping with advanced engineering and manufacturing concepts.

Only machine tools incorporating the ultimate in flexibility, versatility and accuracy can meet aircraft and missile industry requirements today and in the future, but only a very small percentage of existing machines are adequate by AIA standards—most of them numerically controlled.

Most of them are contour and profile millers, along with a few numerically controlled drilling machines, boring, welding and forming units. Nearly all such numerically controlled machine tools are now in production with satisfactory results, and through the unified efforts of manufacturers and users they are constantly being improved.

With these machines, parts can be produced which could not possibly be duplicated on conventional tools, because of the design complexity of parts and the need for consistent, repetitive precision beyond the skill of human operators.

The need for machine tools with ultra-precise movements will become more critical with the advancement of product design, and with the increasing importance of reliability and strength-weight factors.

Yet there is so little numerically controlled equipment available to the industry, in relation to its needs, that it is now necessary to simplify parts so that they can be made on conventional machines. These simple parts must then be incorporated with the more complex ones produced on numerically controlled machines into the same assemblies. Needless to say, this practice does not realize the full benefits of numerical control. But for this very reason, it is not unreasonable to anticipate an unbounded expansion in the use of numerically controlled and highly improved machine tools in the near future.

Today, except for closer tolerances and increased accuracy in fabrication, along with the use of better materials and some streamlining, the basic design concept of most machine tools is unchanged. To a greater or lesser degree, most of today's machines are afflicted with backlash, "sticktion," friction, deflection, and with unbalance and inertial troubles.

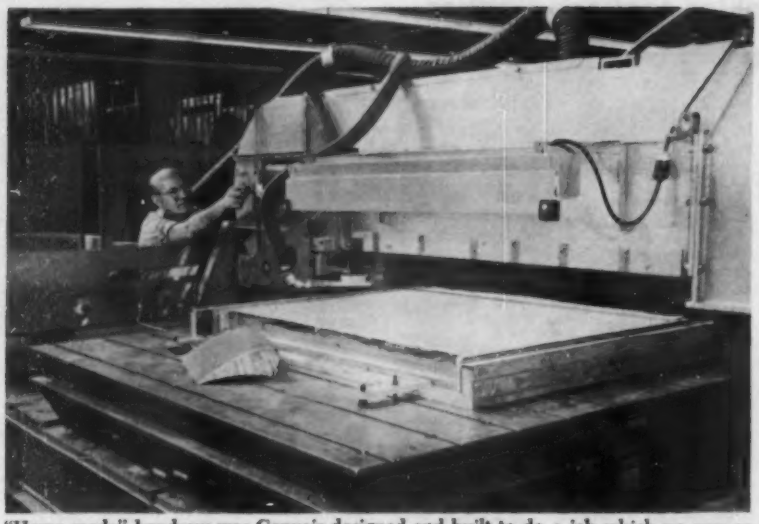
It follows that builders of control systems must design a system that not only can control all machine movements and functions precisely, but which can also detect, measure, and compensate for discrepancies inherent in the basic machine. But such a system would have to be unnecessarily complex, and it would be difficult to maintain at peak efficiency.

What can the machine tool industry do to catch up with the fast changing designs and manufacturing techniques of the Space Age? Basically, it must build machines that are versatile, accurate, and capable of producing parts of such complex configuration that the ingenuity of the structural designer need not be dampened by the question of producibility.

What is needed

Not only must special tools be tailored to the specific needs of users, but standard machines must be greatly improved, too. To get down to specifics:

- All moving members — tables, slides, columns, gantrys, saddles, and the like—regardless of plane of motion should be counterbalanced. In this way, force required to initiate and maintain motion (whether constant, accelerating, or intermittent) will not create inertial problems that must be overcome by operator skill or special control features.
- Some machines are equipped with counterbalance systems employing weights, cables, chains, pulleys, sprockets, and so forth. At best these are only 50% effective, are erratic, and plagued with variables. Such systems should be replaced with electro-hydraulic, pneumatic or other powered systems.
- All parts that move as a tool operates should be mounted on nonfriction precision bearings. All driving mechanisms — racks, pinions,



"Home made" bandsaw was Convair-designed and built to do a job which no saw on the market could do. The saw is straddle-mounted over a 5 x 5 ft table. The blade is in a horizontal plane, is traversed along ways by two independently driven leadscrews. Each end of frame has independent rise and fall. Completely cam controlled, this saw will produce a curved surface on a conical part or a flat surface at compound angles to the base plane

screws, worms — should be equipped with automatic precision backlash eliminators.

• All machines with hydraulic systems should be equipped with adequate heat-exchange devices to maintain hydraulic fluids at a constant preselected temperature.

• Lack of rigidity and stability in a machine is frequently the reason why tolerances cannot be held to specified dimensional accuracies and surface finishes. Convair engineers, analyzing and evaluating several machine tools of equal capacity rating, have sometimes given the nod to a machine of lesser versatility, simply because of its heavier structural design. Generally, machine tools need beefing up for machining high-alloy steels.

• Collection and removal of chips from the work area have a direct bearing on productivity. An efficient chip-collecting system would insure visibility of the work at all times, would prevent clogging of coolant and lubricating systems, and would preclude the need for adaption of a system by the user.

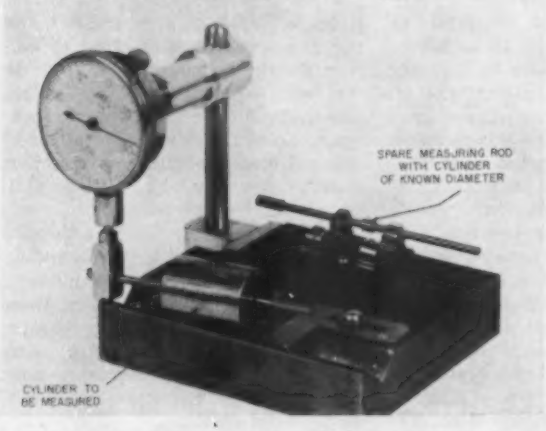
• Skin milling machines are almost invariably furnished without the vacuum table, which is a must in milling wing skins and similar work. The user must design and install this necessary accessory before the mill can do the job for which it is designed.

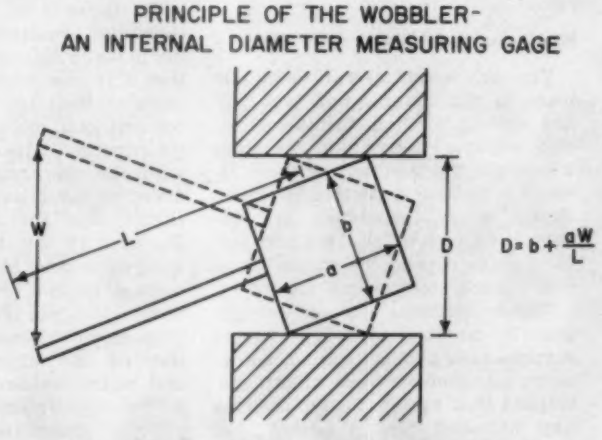
• Because most machine tool builders do not preplan for the addition of vacuum system piping, valving, vacuum table and related equipment, the machine user is faced with such problems as clearance between moving parts and attaching surfaces. It is suggested that machine tool builders look into the feasibility of integrating vacuum chambers and ports, channels and connecting points with the machine table. With such an arrangement, the user need only supply vacuum project plates or sub plates.

Lest it be implied that this is a criticism or censure of the machine tool industry, let it be said here that great strides have been made by machine tool builders in upgrading and improving their products to satisfy new manufacturing techniques. This is evidenced by a visit to any of the installations where numerically controlled and other specialized and automated machines are in operation.

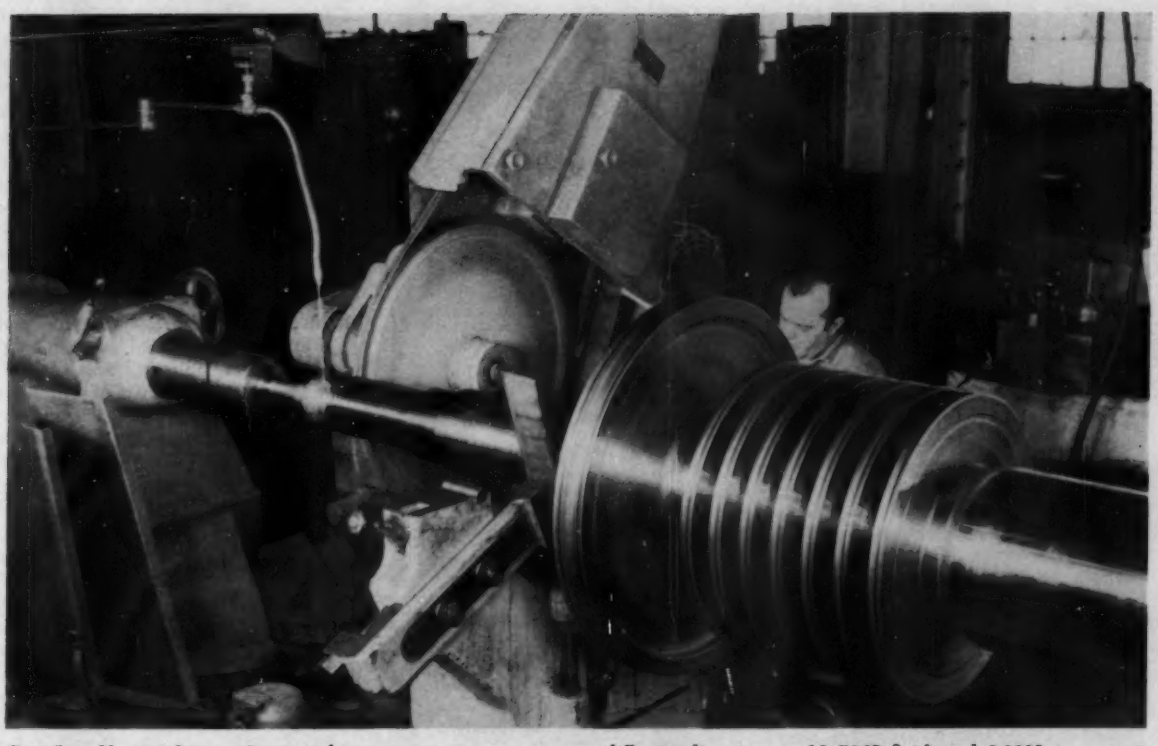
But the gigantic task is far from complete—only complete new concepts in manufacturing tools can keep pace with future demands of air and space mastery.

Inexpensive gage measures hole ID to 0.0002 in. accuracy





This is Naval Ordnance Laboratory's "Wobbler," for measuring the inside diameter of small (about 0.2-in. dia) holes to an accuracy of 0.0002 in. It's basically a cylinder attached to a rod which is connected to a dial. Cylinder is inserted in hole and rod is wobbled, or rocked back and forth, by hand. Movement of the rod is measured by the dial, which indicates the diameter of the hole within an accuracy of two-tenths of a mil



Gets Into Narrow Spaces—Steam-turbine rotors were sent to contract shop for grinding seal fits, because special grinder would have cost $150,000. Special lathe attachment costing $7,000 from Production Machine Co handles 21 fits on eleven different diameters to 16 RMS finish and 0.0003 in. runout. Metal removal is 0.015 to 0.020 in. total, per fit. Cloth belts used are 1¼ to 4 in. wide, and the aluminum-oxide grain is bonded with waterproof resin. Soluble oil is the coolant

Finish those rolls in less time!

Roll grinding with a belt setup takes about one-third less time than wheel grinding, costs less, yet achieves a wide variety of finishes on many types of rolls. Here are some practical tips on how to do the job

By Robert A Leggett, product engineer
Behr-Manning Co, Troy, N Y, Division of Norton Co

Finish is more important than extreme geometrical accuracy in grinding many kinds of rolls and tubes. Here, a belt can do the job at less cost than a wheel, yet produce a great variety of finishes.

For example, proper combination of belts, speeds, coolants and contact wheels can produce a luster finish, or a low micro-inch reading, or it can remove uneven, work-hardened surface material.

A lot of work can be done with a belt, considering that about 2 hp can be put into an inch of belt width. Swarf removal, for instance, is so fast that extra care with coolant filtration is a must. Nor is it necessary to stop a belt grinder to dress, and belts don't have to be changed often.

Because many roll grinding jobs can be done with an attachment on a large lathe, or by converting the wheelhead of a cylindrical grinder, several score plants that once ground or reground rolls with wheel attachments or roll grinders now use belts. Belt-type roll grinding attachments, incidentally, are now on the market.

Here are details of techniques employed in roll grinding and finishing:

Types of work now handled by belt grinding include: dryer rolls, steel rolls for the plastics trade, engravers' rolls, foil-printing rolls, stainless steel rolls for textile printing, chrome-plated rolls, aluminum lighting standards, automatic-lift plungers, pistons for elevators, gun barrels, steel and zirconium tubes.

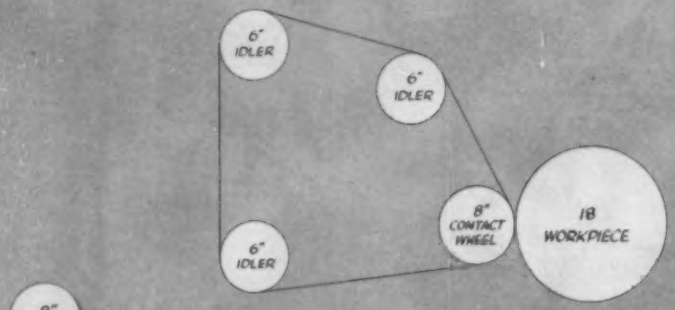
Finishes produced by belt grinding depend upon many factors, but ordinarily a uniform pattern and some luster are adequate, rather than a mirror finish. Here are some typical examples of finishes that can be achieved with belts:

- Nickel-plated thin-wall tubing, with plating 0.030-0.040 inches "high' at the ends, ground to 5-8 rms and to 0.00025 inches for roundness TIR, and straight over 36 inches length, can best be ground by a belt, because of its faster, cooler cutting action. Cutting oil must be used, however, to avoid tearing the nickel, and to deliver the required finish.
- Carrier rolls for textiles need good finish, but out-of-roundness of 0.015 inches can be tolerated. Here, good finish is obtained by working on the slack of the belt. The same is true of finishing elevator plungers.
- A "spun finish" can be produced

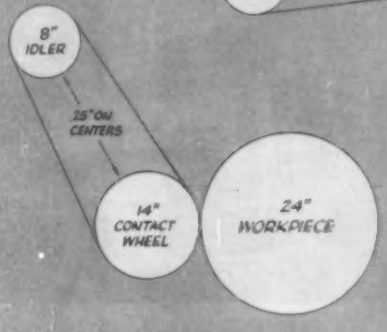
Finish those rolls in less time . . .

Basic arrangements of belt grinding attachments

(Dimensions on sketches do not denote the only sizes of attachments built)

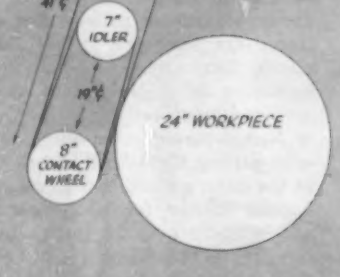


Ryman-made lathe attachment in conventional setup with contact wheel. Work diameter can range from 3 in. to 12 ft.

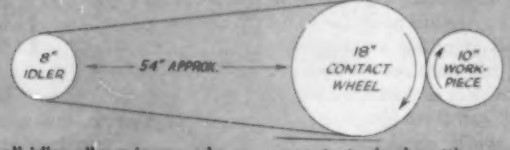


Older lathe attachment design (Production or Curtis) allows either contact wheel grinding or strapping on free portion of belt (if idler end is moved forward). Tracking difficulties may arise if contact pressure is high

Ryman attachment pivoted 180° from position shown in drawing at top, to permit strapping for fine finish or light stock removal



Back-up belt behind abrasive belt on Ryman attachment stiffens grinding action, increases stock removal rate



Small idler allows increased wrap on contact wheel, putting more horsepower into a cut. This type of attachment, built by several firms, is similar in principle to cylindrical grinder conversion

on tapered aluminum street light standards by using a combination of traverse and grit.

- Plunge grinding of assembled rotors smoothes the rough, uneven surfaces which result when the laminations are stacked and assembled.
- Rubber printing rolls can be finished in 2 minutes, as against 45 to 60 minutes by hand work.
- Work-hardened chilled iron rolls (probably the most difficult of all belt grinding jobs) if ground with a wheel may have their finish spoiled by chatter if wheelhead condition is not good. With belt grinding, on the other hand, good finish is obtainable. But stock removal rate is only a fraction of that with steel rolls.

Elements of a setup — For roll grinding or polishing, either a lathe attachment (produced commercially by several firms) can be used, or a cylindrical grinder can be converted. In any case, the belt runs over one or more idler pulleys and the powered contact wheel (see sketches). The contact wheel presses against the work with sufficient pressure to make the abrasive grain penetrate to the desired depth.

Process variables

Important considerations here are selection of abrasive grain, bond and belt backing material, and coolant, characteristics of the contact wheel.

Cost of attachments—Belt grinding attachments for lathes and roll grinders cost from $1500 to $3000. On the other hand, a cylindrical grinder may be converted for the job by mounting an air-hydraulic tension grinder on the wheel-head slide, slotting the wheel guard to receive the belt. The belt can then be covered with an auxiliary guard. Finally, the grinding wheel is replaced by a contact wheel.

There are attachments available for cylindrical grinders, too. Sometimes conversion is cheaper than buying such an attachment. In other cases, the cost of a large contact wheel eats up the difference. But for the kind of work it is intended to do, a belt does the job for less cost than a wheel.

Accuracy of work—With a lathe attachment, tolerance equal to a machine's basic capability can be obtained.

Stock removal rate depends upon such factors as material hardness, type of material, surface feet per minute, traverse speed, belt characteristics, and the contact wheel. If a setup is correct, the reduction per traverse may amount to a few tenths in the case of a chilled iron roll, or

to several thousandths on iron, steel, or aluminum. Metal removal rate is aided by traversing the belt, by rotating the work as slowly as possible, and by applying continuous pressure in proportion to available power.

Grit materials—Aluminum oxide is used for most belt grinding operations on iron and steel, and silicon carbide when a fine finish is desired. The latter grit may also be used for stock removal on nonferrous materials.

With either grit material, the grain may be bonded to the belt with glue (either for dry finishing or for grinding with oil) or with resin, which gives a stronger bond than glue and is water-resistant.

A paperbacked belt costs two thirds as much as a cloth belt, but the latter is stronger, holds the grain better, and reduces time lost in belt changing.

Grit sizes—Grain sizes for roll grinding range from coarse (60 to 80 or coarser) for the worst stock condition, to 240 and higher for final finishing. Ordinarily, an operation can be started with 120-grit belts, but cast-iron drums and chilled-iron rolls usually require starting with 36-40 grit.

Belt speed—Here, the usual range is 4000 to 5000 fpm (higher speeds generate heat and glaze the belt). But such materials as titanium, Zircaloy, certain grades of stainless steel, and other tough alloys must be belt ground or polished at lower speeds. Titanium, for example, has been ground at 750 fpm.

What belt grinding won't do—Form grinding of rolls is impractical with a belt, especially if close tolerances are involved. This is because a belt is limited by its ability to run over formed pulleys in generating a precise form or radius. For the same reason, face grinding of a shoulder and an adjacent roll is impractical.

Contact wheels—For stock removal, a hard rubber (90 durometer) contact wheel with 45° serrations, ¼-in. land, and ⅛-in. groove provides aggressive cutting action, and sheds dulled abrasive from the belt to eliminate glazing or plateauing of the grain. More belts are thrown away because of glazing than complete shedding.

For finishing work, rubber facing on the contact wheel is softer (may be down to 30 durometer), and the angle of serrations may be reduced to as little as 8°, with lands wider than the grooves. Even smooth-faced contact wheels may be used for finishing.

Fine Finish—Steel rolls for Flexographic printing, measuring 56 x 4.810 in., are polished by a lathe-mounted Ryman 500 roll grinder. The roll is rotated at 300 to 350 rpm. An 8-microinch finish is attained here with cloth abrasive belts, usually with a grit sequence of 150 and 240, depending on the roll condition. Belts are 2¼ x 82 in., run at 3500 sfpm. On final finishing, a fabric back-up belt is used

Strapping vs contact wheel—If the problem is stock removal plus concentricity and straightness, a contact wheel is preferable. Finishes down to 3 rms can be attained, although users of belt grinding equipment are usually satisfied with commercial luster.

Strapping (grinding with the slack of the belt) puts more abrasive in contact with the work, is thus a faster way to remove tool marks and bring up luster if the roll is out of round.

This method, which is primarily a finishing operation, will not distort work that is round to begin with, but on the other hand it will not correct existing out-of-roundness. Sometimes a glue-bonded belt is used in strapping, but it does not hold the grain as firmly as other bonds, although it is less costly.

Work rotation—The contact wheel and the work should not rotate towards each other (like a pair of gears rolling in mesh). The wheel and the work should rotate in the same hand, say clockwise.

Work speed range is 25 to 200 fpm. And while stock removal is better at slow speeds, better finish is produced at high speeds. In any case, speed should not be so high that penetration of the work by the grain is impaired.

Traverse rate ranges upward to 6 to 8 fpm, depending upon work diameter and surface speed. There is no hard and fast rule: The rate must be worked out on a basis of the job and required finish.

Coolants — Although most belt grinding is done dry when a lathe attachment and fast traverse are employed, coolant helps control distortion in some instances, as in grinding thin-wall tubing (a 40:1 soluble oil mixture works well).

If stock removal is heavy and distortion is not important, the lubricating effect of a sulphur-chlorinated oil can increase belt life 10:1 over soluble oil—and a premium-priced waterproof belt is not required.

Generally, a wide range of coolants can be used in belt grinding to produce a fine finish, handle stock removal, or both.

Filtration—When oil is used as a coolant, it must be filtered with a filter of greater capacity than is common with a wheel grinding setup. Many belt grinding troubles can be traced to inadequate filtering capacity and to failure to cope with the faster metal removal rate of belts.

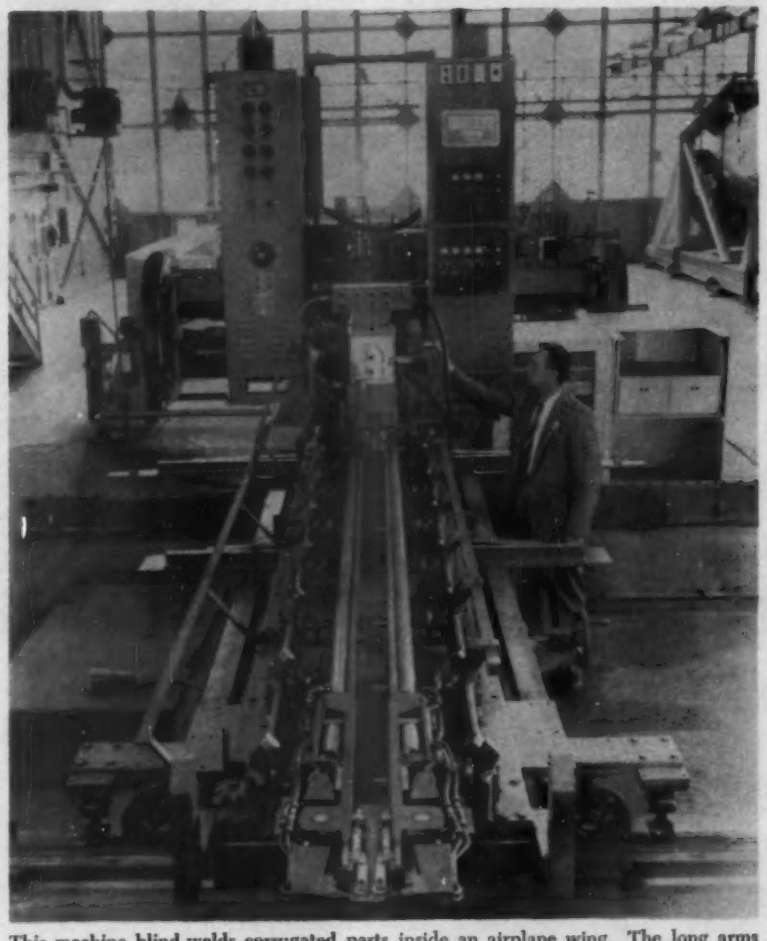
Defects produced by belt grinding most commonly reported are chatter marks and barber-pole spiral. Chatter marks can be caused (1) if the belt joint is too thick, (2) if the contact wheel is out of balance, (3) by poor or worn bearings, (4) by excessive grinding pressure, and (5) by work vibration or whip.

Probable causes of barber-pole spiral can be narrowed down to (1) excessive wheel pressure, (2) too-rapid wheel traverse, (3) misalignment of the contact wheel, (4) belt cupping.

Such troubles may be corrected by realigning the contact wheel, by relieving the contact wheel edges to "fade out" the pressure, or by replacing the contact wheel if the rubber is beginning to separate from the core. If the belt cups, increased tension on the belt will flatten it. If not, the crown on the idler pulley should be changed.

Long-armed welder reaches

'Here's a machine that will reach through a small opening and make blind spotwelds at the other end of a large airplane wing. A major problem solved by the device is how to exert enough squeeze force at the end of the long booms to make a good spotweld



This machine blind-welds corrugated parts inside an airplane wing. The long arms push the welding electrodes in on either side of the web to be welded and can reach as far as 150 inches, placing the spotwelds exactly where they are needed

Try holding both arms straight out in front of you and pressing your two index fingers together. You can't exert much squeeze force that way, but, if somebody ties your wrists together, you can squeeze pretty hard.

That gives a general idea of the design principle that lets this machine make blind spotwelds inside an airplane wing, all the way down at the other end, 150 inches away. Built by Sciaky Bros, Inc, for North American Aviation's Los Angeles Division, the machine will weld stainless steel wing assemblies on the B-70.

In a wing that has corrugated shear webs running from the tip of the wing to the root, the webs are held in place by U-shaped members (shear caps) that have been previously welded to the inside surfaces of the wing. But the webs and caps must also be welded together.

Welding a web to one cap is not difficult, because the wing skin is built in two halves, top and bottom. For this operation, the parts are accessible to a portable welding gun.

However, if the other half of the wing is put in place, it's something like putting the lid on a long, flat box with a stiffener down the middle and leaving an opening in only one end.

Long reach

This oversimplifies the situation, of course. For one thing, the box isn't rectangular, and for another, there's more than one stiffener. Nevertheless, the problem for Sciaky was to build a welder that would fit a 3 x 8-in. opening on each side of the web and make spotwelds as far as 150 inches inside the opening.

The machine actually does resemble, in principle, the outstretched arms mentioned above. On the end of each tubular arm is a pivot that supports an electrode on its front end. When the back end of the pivot is driven outward by a hydraulic cylinder and cam arrangement, the electrode moves in to make the weld.

So far, so good, but the force applied for welding would simply bow the arms if we didn't "tie the wrists together." This is done with a pair of T-slotted bars (one on each side of the web) that are pinned together through tooling holes previously punched in the web.

During an actual assembly, the T-slotted bars are installed *before* the top skin is placed in position. The rigging pins are inserted from one side and are secured on the other by wedge locks that fit grooves in the pins. These locks are all attached to a wire-rope lanyard so they can be disengaged later when the welding operation has been completed.

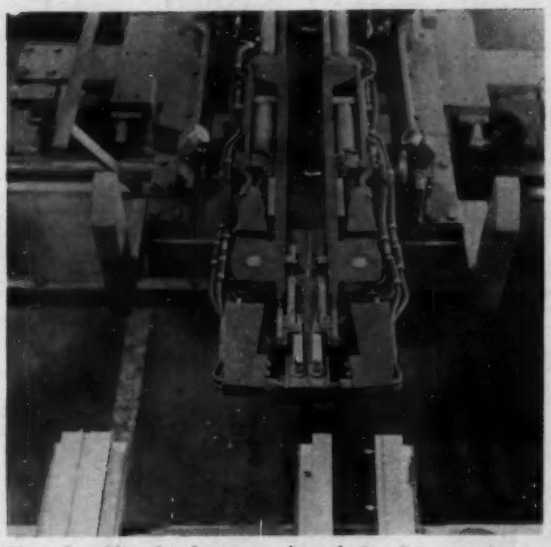
After the tooling is installed and the top wing skin is positioned, the T-guides of the welder are inserted into the T-slotted bars. Then the machine is ready to weld.

The electrodes are offset vertically, so they can reach upward to make spotwelds at the top of the shear web. Electrode force is adjustable up to 2500 lb.

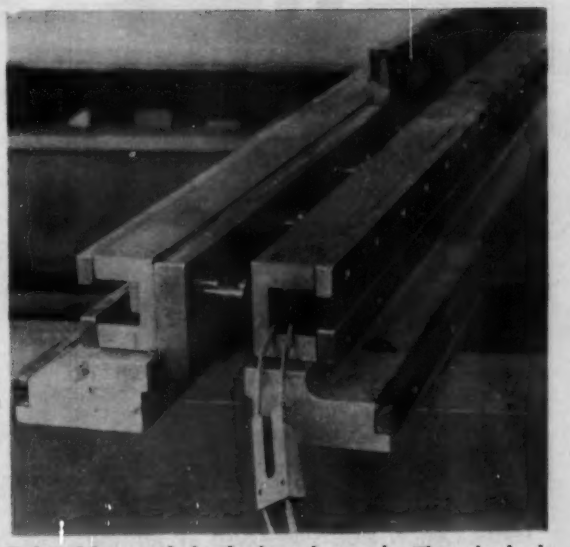
But accurate location of the spots along the web is also important. The electrodes must put them only where the corrugated shear web makes contact with the shear cap.

To accomplish this end, a variable-speed, d-c gear motor moves the welding equipment in successive steps along the length of a web by means of a rack arrangement. This

"inaccessible" spots



Pivoted welding heads can go through 3 x 8-in. openings to make blind welds. Hydraulic devices drive rear of heads outward to apply welding squeeze force on electrodes



T-slotted bars guide heads along shear web. They also buck welding squeeze force, giving heads something rigid to push against. Solid block in front is starting-end spacer

mechanism, together with locators on the gun, make sure that the welds are in the required positions.

The two tubular arms hold the electrodes in alignment in the fore-and-aft direction, and the T-slotted bars hold horizontal and vertical alignment, in addition to withstanding the reaction of the electrode force.

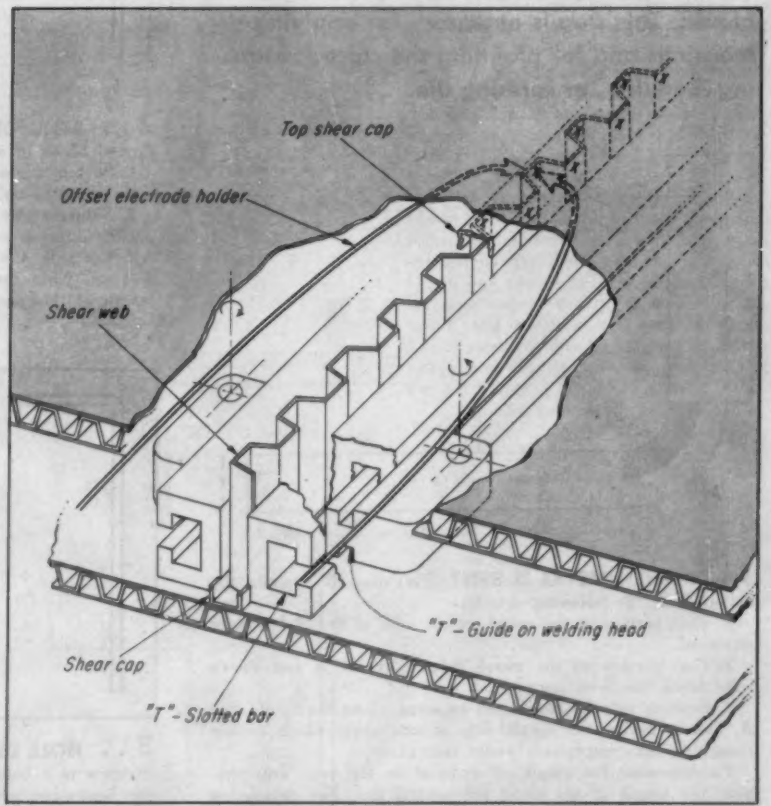
Traveling transformer

The arms are rigidly mounted to a supporting structure that rides on wheels with anti-friction bearings. An interesting feature is that, in order to minimize throat depth, the transformer is also mounted on the supporting structure and rides along with the arms as they push the welding heads into the wing.

In addition to this 100-kva transformer (22,000 amps max secondary current), the supporting structure carries single-phase Dekatron controls, a self-contained water cooling system, and a hydraulic power pack.

In the event the machine has to weld an oblique section, the supporting structure is mounted on a trunnion and guide ways. Therefore, it can be turned either right or left in a horizontal plane.

Supporting all this is the main carriage that moves sideways on tracks to carry the equipment from one setup to another.



Highly schematic view of welder in operation, spotwelding shear web to top shear cap, which is already attached to top wing skin. Offset electrode holders rotate about pivot and reach upward to place spots at top of web

14 steps TO DESIGN A DIE

STEP 13

Dimensioning and Notes

Part 2 — Blank Development for Bent and Formed Parts

By J R PAQUIN, supervisor,
Tool Engineering Dept.,
Cleveland Engineering Institute

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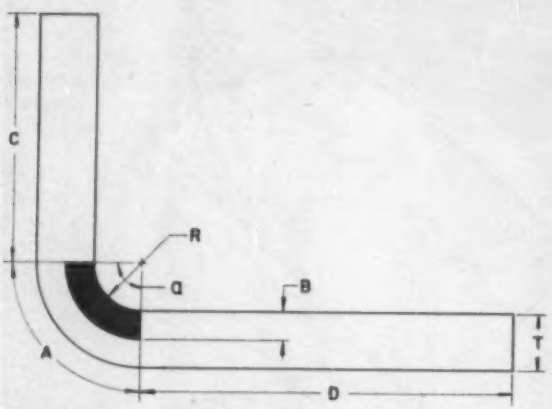
Blank development means the developing of bent, formed, and drawn workpieces into flat blanks. This step is necessary for applying dimensions and for planning the cut off, blanking, bending, or forming die.



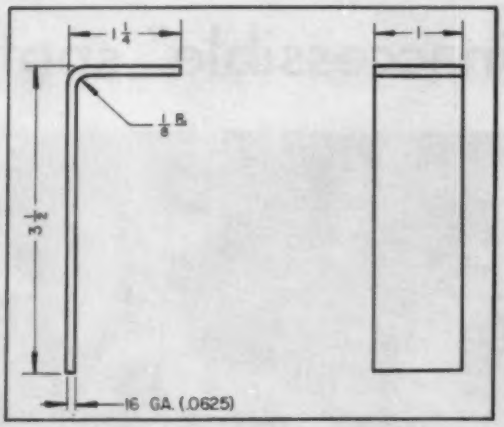
1 . . WHEN METAL IS BENT. This diagram explains the action. Note the following details:

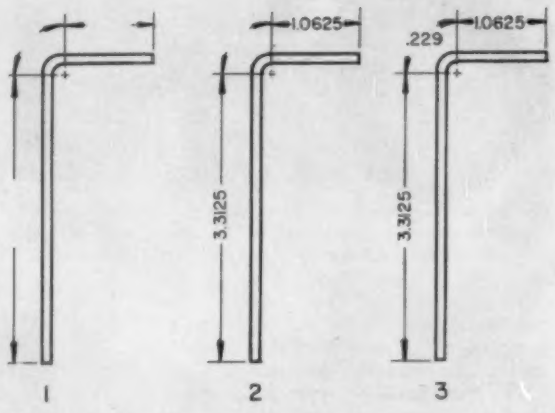
1. That portion of the metal on the side of arc *A* has been *stretched*.

2. That portion of the metal defined by arc *a* and shown solid black has been *compressed*.

3. Bending may be considered to occur along the inside line *B*. This would be the neutral line or axis along which neither stretching nor compression would take place.

To determine the length of material in the bent arc, compute the length of arc along the neutral line. For calculation purposes, the distance *B* will be considered as either ¼, 1/3, or ½ of thickness *T*, depending on the size of radius *R*. Note that adding *A*, *C*, and *D* would give the length of the blank.



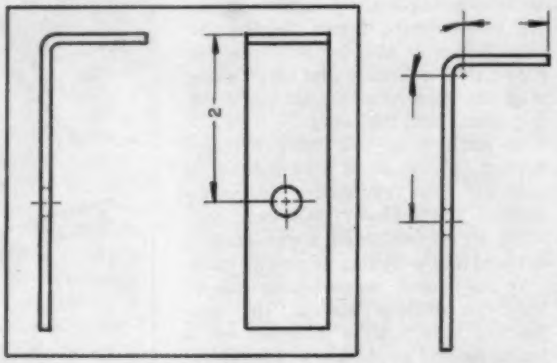


2 . . BEND DEVELOPMENT. To develop a bent or formed blank in an orderly way, proceed as follows:

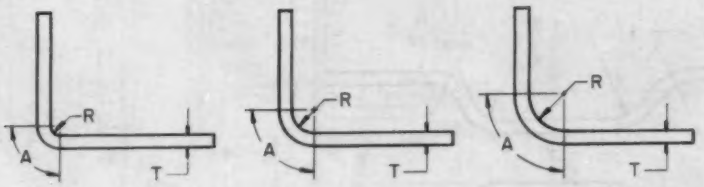
1. Sketch a side view or section of the part, to enlarged scale if necessary, and apply dimension lines as shown.

2. Subtract the sum of the radius and stock thickness from outside dimensions. Fill these in decimally on the sketch.

3. Compute the length of arc and write it in the proper position. Note that adding all dimensions gives the over-all length of this part.

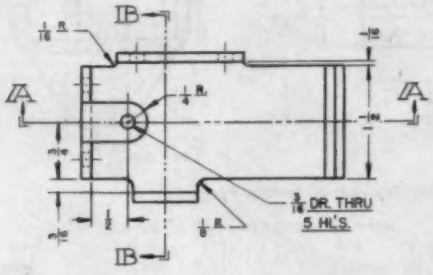


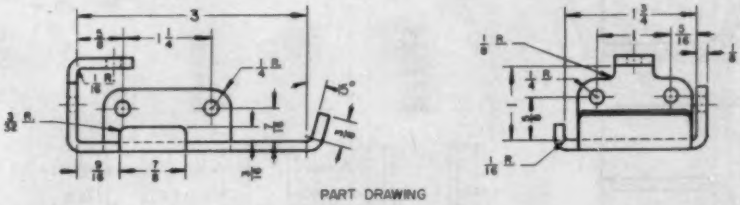
3 . . HOLE DIMENSIONS. To establish the developed distance to a hole when it is dimensioned from the surface of the bent edge, add the part thickness and the radius and subtract their sum from the given dimension. To this value, add the developed radius, taken from the sketch, and the length of the straight arm.



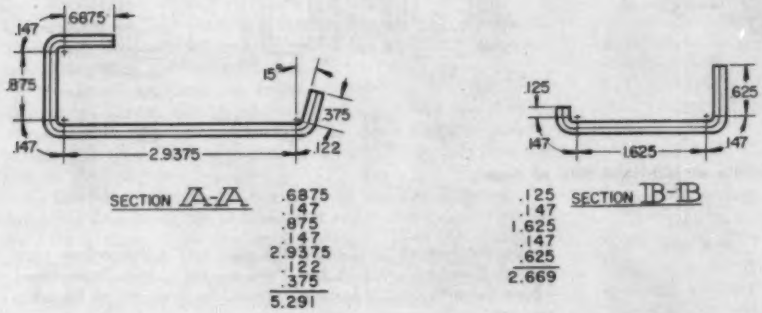
	R Inside radius smaller than stock thickness	R Inside radius from 1 to 2 times stock thickness	R Inside radius more than twice stock thickness
90° Bends	$A = \left(\frac{T}{4} + R\right) \times 1.5708$	$A = \left(\frac{T}{3} + R\right) \times 1.5708$	$A = \left(\frac{T}{2} + R\right) \times 1.5708$
1° Bends	$A = \left(\frac{T}{4} + R\right) \times .01745$	$A = \left(\frac{T}{3} + R\right) \times .01745$	$A = \left(\frac{T}{2} + R\right) \times .01745$

4 . . FORMULAS FOR BENDS. This chart gives all of the formulas that you will require for developing corners of bent and formed workpieces. Observe that there are three possible conditions and that each requires the use of a different formula. In the first, the arc has a radius *smaller* than the stock thickness and appropriate formulas are given below the illustration. In the second, the arc is between one thickness and two thicknesses of stock, and in the third the arc radius is greater than twice the stock thickness. The upper formulas apply for 90° bends, which are most common. The lower formulas apply for bends of one degree and they are used for computing the lengths of bends at angles other than 90°. Multiply the value found by the actual number of degrees through which the arm of the part is bent.





PART DRAWING



SECTION A-A

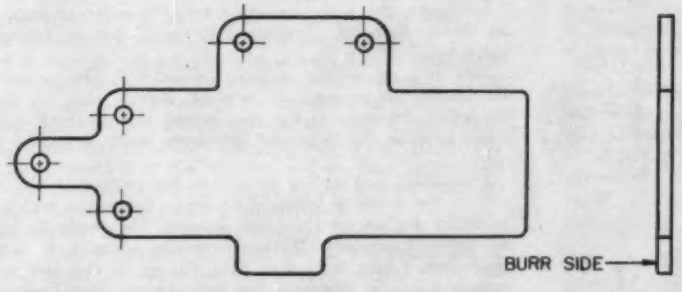
.6875
.147
.875
.147
2.9375
.122
.375
5.291

SECTION B-B

.125
.147
1.625
.147
.625
2.669

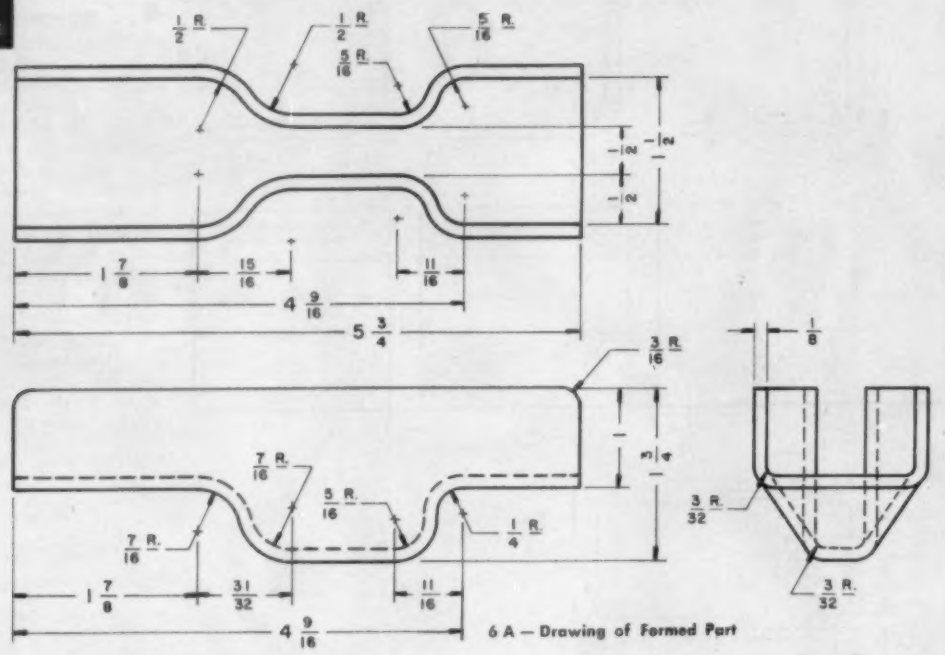
5 . . BLANK DEVELOPMENT. At the upper portion of the illustration is shown a drawing of a part containing a number of bends. Two sections, a horizontal one marked *A–A* and a vertical one marked *B–B* are taken through the part and drawn below it. Dimensions are applied directly to the sections. Horizontal and vertical dimensions are found by addition and subtraction of part drawing dimensions. Dimensions of arcs are found by calculation, using the formulas given. After all dimensions have been applied, the developed flat blank can be easily drawn, as illustrated, below the sections. Note that adding all dimensions for both sections gives the length and the width of the blank, and a rectangle can be drawn which will be the length and width of the finished blank. The drawing is then completed by taking dimensions directly from the sections and the part drawing.

(Continued on page 110)

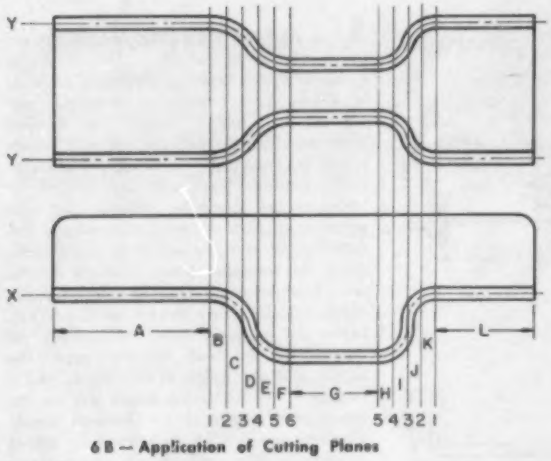


DEVELOPED BLANK

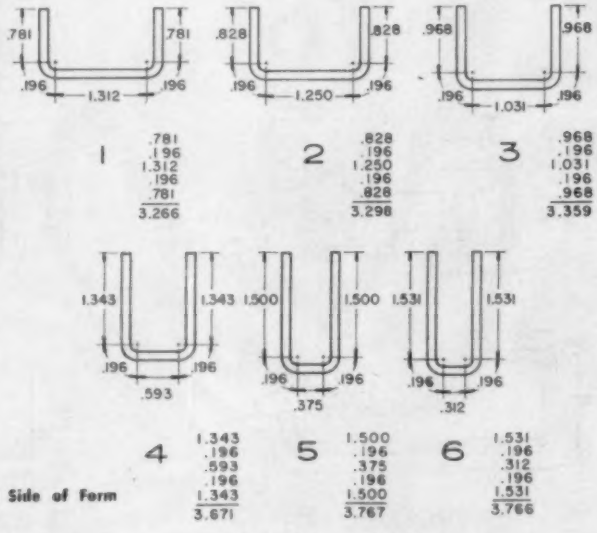
Dimensioning and Notes . . .



6 A — Drawing of Formed Part



6 B — Application of Cutting Planes



6 C — Sections at Left-Hand Side of Form

6 . . FORMED-PART DEVELOPMENT. Although no more difficult, the development of a formed part requires more steps than one that is bent. The difference between bending and forming basically occurs in the straightness or curvature of the bend line. In bending, portions of the blank are raised to some angular position and the line of bend is straight. A forming operation is similar except that the line of bend is curved instead of straight.

A formed workpiece is developed by dividing it into sections and finding the length of each section by the methods employed for developing a blank for a bent part. Lengths of arcs are determined by employing the formulas given in Fig. 4.

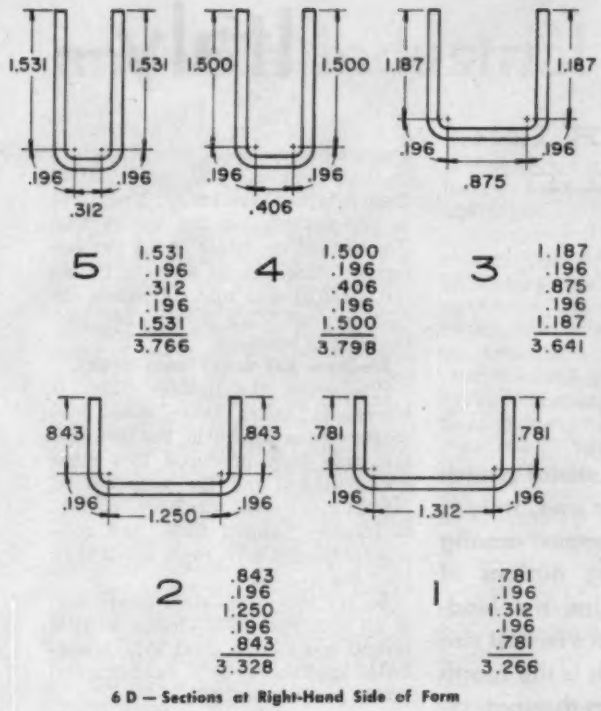
At 6 *A* is shown a drawing of a formed workpiece. Wherever the bend occurs in a straight line, it is considered as being bent, and wherever the line of bend is curved, it is considered as being formed.

The first step is to draw an accurate layout of the top view and front view, as shown at 6 *B*. An enlarged scale is often used for increased accuracy. Next, draw evenly spaced lines to divide the formed portions of the part into a convenient number of divisions. Extend the lines so they cross both views. These are actually cutting-plane lines. Sections are to be taken through each.

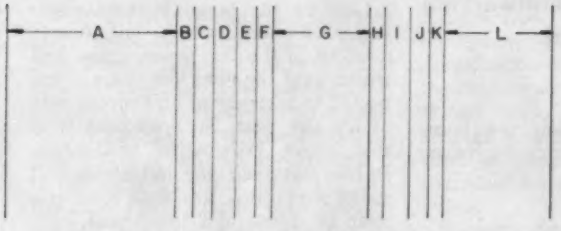
Obviously, the more sections taken, the more accurate will be the development. However, this should not be carried to extremes.

Now draw the various sections, 6 *C* and 6 *D*. Observe that the bottoms of the sections are revolved, that is, they are shown the actual thickness of the part instead of thicker as cutting-plane lines in the front and top views would appear to indicate.

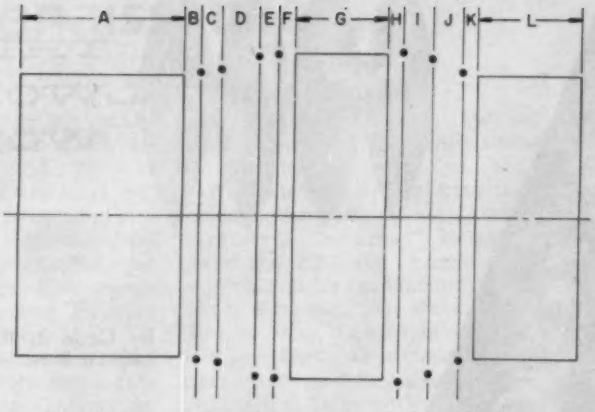
Dimensions are applied directly to the sections in the same way as for ordinary bends. First apply dimensions which can be taken directly from the part drawing. Then scale the layout for other dimensions. Measure carefully along each cutting-plane line, taking a reading from the top of the part to the bottom where it intersects the cutting-plane line. Lengths of arcs are calculated in the same manner as for regular bends.



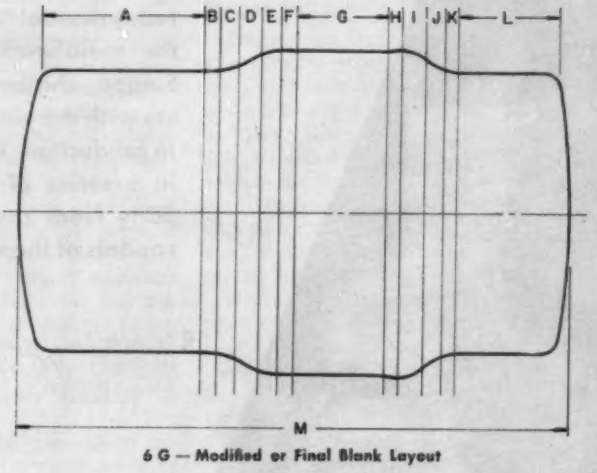
6 D — Sections at Right-Hand Side of Form



6 F — Distances on Forms Along Y, View 6 B



6 E — Blank Layout From Distances Along X, View 6 B



6 G — Modified or Final Blank Layout

Under each section, enter the various lengths and add them. These will be developed lengths across the workpiece as measured along each cutting plane line.

Now determine linear or length dimensions. On the front view of the layout, draw a line lengthwise to divide the bottom of the part in two. This is shown as line *X* on 6 *B*. The length of this line must now be measured because it is the same as that of the developed blank.

To draw the blank layout, proceed as follows: Refer to the developed lengths of the sections and select the *longest* dimension. On a sheet, draw two light horizontal lines this distance apart. This will be the width of the developed blank. On the layout 6 *B*, measure distance *A* and on the initial blank drawing, 6 *E*, apply two vertical lines the same distance apart. Next, measure distances *B*, *C*, *D*, etc, and draw vertical lines these distances apart on the blank drawing. Observe that these distances are measured along the *curve* of the part and on line *X*, view 6 *B*. Provide yourself with a diemaker's flexible steel scale. Carefully bend the scale to the contour of the line before taking a reading. Values for arcs could be calculated instead.

When you have finished laying out the vertical grid lines, draw a horizontal centerline and mark points on the vertical lines to dimensions of the sections and in their appropriate locations. Dimensions are marked an equal distance from the centerline because the blank is symmetrical.

Next, modify the lengths of the upper and lower lines in order to produce an accurate blank layout. The blank length, measured along the centerline, is the same as line *X* on the layout at 6 *B*. However, this is not necessarily the same length as that of lines *Y* along the upper and lower edges of the part. On another sheet, measure the formed portions of the workpiece along line *Y* and draw the divisions as shown on the layout at 6 *F*. Lengths of the upper and lower lines of layout 6 *E* are then modified, and the result is the completed blank development shown at 6 *G*. Points are connected with a French curve.

Observe that the left and right sides are large radiuses instead of straight lines because of the modification. The small arcs at the corners are 3/16 in. as taken from the part drawing.

Next, the drawing of the developed blank would be fully dimensioned. This drawing is used for tracing or laying out the opening in the blanking die. However, the die opening is not dimensioned on the die drawing. Instead, a print of the blank development is sent to the shop along with the die print. The diemaker will layout and cut two trial blanks to dimensions given. These will be of the same material and gage thickness as the part drawing specifies for finished workpieces.

The forming die is always completed before the blanking die is made and one of the trial blanks would be actually formed in it. Should the formed part be accurate and within limits established by the part drawing, the diemaker then uses the other trial blank as a templet for machining the die hole. More frequently, some modification is necessary because of the way in which the metal flows in forming. The diemaker would then make two more trial blanks, adding or removing stock in an attempt to correct any irregularity. One of these would be formed and checked for accuracy. This process is continued until an accurate part is produced.

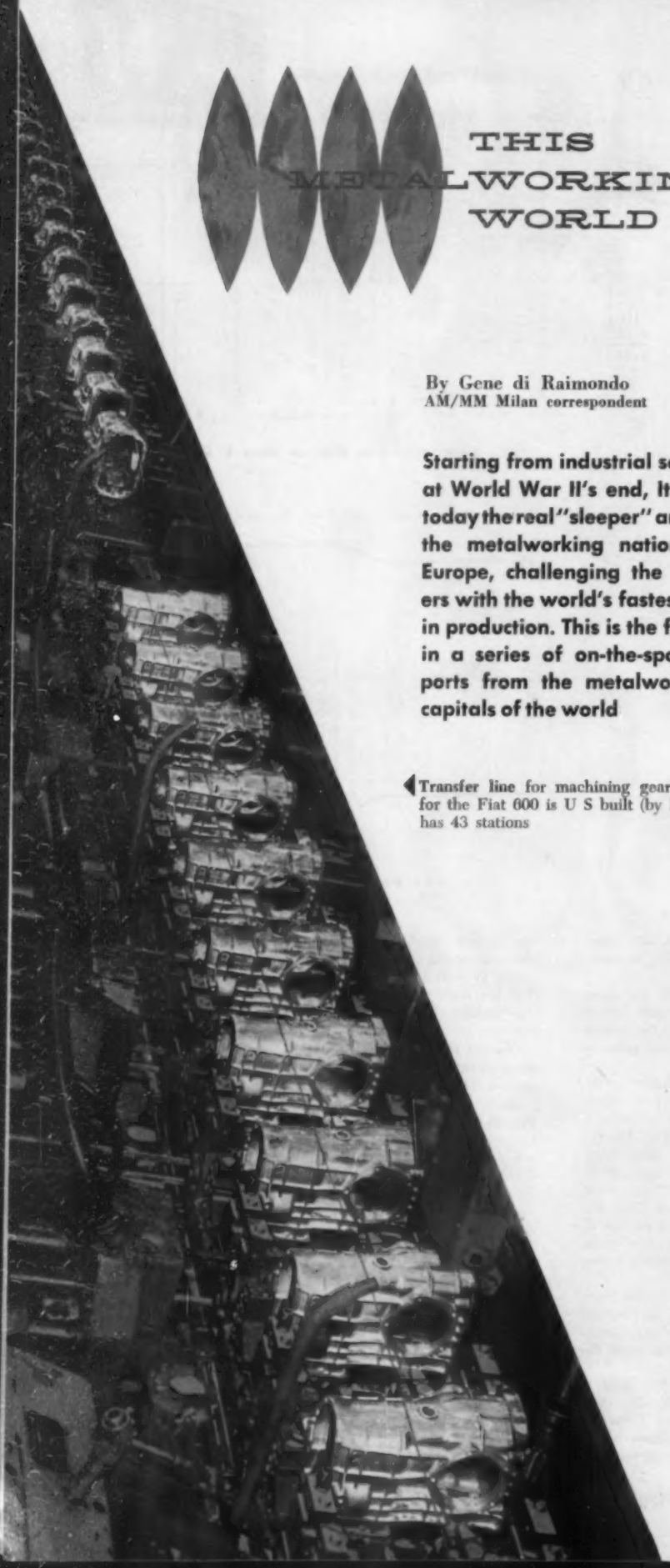
To be continued in an early number.

THIS METALWORKING WORLD

Italy—

By Gene di Raimondo
AM/MM Milan correspondent

Starting from industrial scratch at World War II's end, Italy is today the real "sleeper" among the metalworking nations of Europe, challenging the leaders with the world's fastest rise in production. This is the fourth in a series of on-the-spot reports from the metalworking capitals of the world



◀ Transfer line for machining gear boxes for the Fiat 600 is U S built (by Natco), has 43 stations

Italian businessmen, like American football coaches, will never admit their prospects are bright. They love to cry poverty, on the theory that this softens the heart of the tax collector. Consequently, when an Italian industrialist says that conditions are "not so bad," it's a safe bet that business is booming.

Business has never been better.

Production, the Italians claim, is increasing faster there than anywhere else in the world. For instance, last year Italy produced 18% more goods than it did the year before, capital investment rose 6.8%, national income jumped 6.6%, and consumers bought 4.8% more goods than they did in 1958.

So far this year, steel production is up 30% over 1959—motor vehicle output has risen a good 50%, household appliances 33%, and capital goods production 19%.

And there is no sign of a letup.

Leading the boom is metalworking production, which has nearly doubled in the last seven years, and which over the next five years is expected to increase at an average rate of 5% per year. To keep pace with this rapid growth in production, Italy's metalworking industries will spend something like $700 million a year for plant and equipment.

Steel output keeps pace

Bolstering Italy's fast metalworking expansion is an even more spectacular gain in steelmaking, which has tripled its output over the last decade. And even the most conservative estimates predict a production increase of at least 5% a year from here on out. Actually, steel output jumped nearly a third in the first four months of this year over comparable 1959.

The nonferrous metal industry is also keeping pace with the growth of Italian metalworking. Again, that magic figure, 5%, represents annual anticipated increases in production over the next several years. And, as with steel and metalworking generally, nonferrous output so far this year has far exceeded the expected 5% increase.

As to metalworking itself, there is little doubt that its prosperity depends upon that of the automotive industry which is at once the anchor and pulse of the country's economy. Just look at the record: in 1959 Italy produced 24% more cars (500,000)

and the industrial renaissance

than it did in 1958. This year, production is running 50% ahead of comparable 1959!

Even the most conservative of estimates foresees an annual increase of 6% in production over the next five years. A whopping big share of this (around 80%) will go to Fiat, the giant of Italy's automotive industry, with the other 20% or so divided by Alfa Romeo, Lancia, O M, and Autobianchi, in that order.

The smallest of Italy's Big Three automakers, Lancia, has undertaken the most ambitious expansion project. Moving out of its obsolete Turin plant, Lancia is building a $50-million plant in nearby Chivasso which will feature ultramodern body presses, painting and assembly installations. Scheduled to go into operation in 1961, the plant is expected to turn out 250 cars a day.

Auto exports zoom

Fiat, by way of contrast, produces more than 1500 cars a day, while Alfa Romeo, Lancia, O M, and Autobianchi together are turning out something like 75,000 units a year. Nearly 50% of all Italian automotive production is shipped abroad, and it is the export market that will call the shots for expansion from here on out. If foreign sales continue to boom, the Italian auto industry expects to increase capacity at least 30% by 1965.

Domestic demand for Italian automobiles is tremendous. Incomes are rising fast, and there is still only one car for every 25 people.

But if domestic demand for cars, motorbikes, and anything on wheels is great, need for household appliances is even greater. Italy's appliance industry is young, yet it faces the tremendous task of supplying refrigerators, washing machines, water heaters, vacuum cleaners, and gas and electric ranges to a market that is only 20% saturated.

From a base index of 100 in 1953, the nation's output has skyrocketed to around 400 this year—and still demand is no where near fulfilled. It is expected that the industry will have to increase production 20% a year over the next five years.

Less spectacular, but still on the upswing, is output of industrial machinery (primarily machine tools), which is about one-and-one-half times what it was in 1953. In the next five years, this industry is expected to rack up steady but unspectacular production gain of 3% annually.

Conversely, Italy's electrical machinery industry has been doing badly: From a base index of 100 in 1953, production has dropped to less than 94 this year. Nevertheless, the industry anticipates an annual 7% gain over the next five years.

The Italian transportation equipment industry (aircraft, ships, railroad stock) has been chalking up steady gains in the last few years, and is expected to be 50% greater by 1965 than it was in 1958.

The world-renowned Olivetti typewriter is largely responsible for a meteoric 10% annual gain in the production of Italian office machinery. Over the next three years, this industry will sell something like $380 million worth of typewriters, computers, and teletypes.

National income has increased greatly since the War, and with it purchasing power. This coupled with introduction of easy credit terms for the first time in Italy, has put the Italians in a buying frenzy. Long-awaited prosperity has at last given them a chance to satisfy pent-up yearning for a higher standard of living.

Topping domestic demand is increasing acceptance in world markets of such Italian metalworking products as automobiles, bubble cars, motorbikes, office equipment, machine tools, and even some household appliances. Roughly 40% of all Italian metalworking production today goes for export. Of the 500,000 motor vehicles produced in Italy in 1959; for example, about 220,000, or 45% were exported. The percentage is about the same so far this year.

Little U S investment

But even with such unprecedented markets for Italian products at home and abroad, and even though Italy is a member of the highly lucrative European Common Market, there is to date little U S investment in Italian metalworking.

To be sure, Remington Rand and IBM have plants in Italy, but their combined output is small beside that of Olivetti, which produces 70% of the nation's office machines.

Officially, there is no U S company involved in Italy's automotive industry, although it was recently reported that Willys has formed "Willys Mediterranean" in Sicily and will produce Jeeps for the Mediterranean area, Africa, and Asia.

With such sparse American interest in Italian metalworking, there is very little "sourcing." Remington Rand and IBM, for example, don't ship their Italian production back to the U S market. But the managing director of an Italian subsidiary of a U S appliance maker (there are two such in Italy—Admiral and Philco) reports that he recently placed several orders for Italian-produced and designed refrigerators in the U S.

Wages still low

There is no doubt that Italian metalworking is prospering as never before, but that prosperity does not extend to wages paid workers in the industry; this could mean trouble.

A semi-skilled man, for example, gets an hourly take-home pay of less than 75¢, and a skilled worker makes only 5¢ or so more. This take-home pay, incidentally, includes part of 35¢ an hour in fringe benefits.

While wages in metalworking have more than doubled since prewar years (as they have everywhere else), in recent years they have failed to keep pace with productivity gains—increasing only at a rate of 5% every two years.

Increased production is increasing the amount of overtime, but only for skilled workers. This strange practice is explained by the fact that the normal workweek is 44 to 48 hours. If business is good, as it certainly is now, another shift is added, and only skilled workers go on to overtime.

As to overtime pay, base hourly wages increase 20% for the first two hours, and 30% thereafter. Holiday work pays 50% over base, and holiday night work 60% for the first eight hours, 75% thereafter.

But even though metalworking pay is lagging behind prosperity, there have been few serious strikes.

Paradoxically, Italy has one of the highest unemployment rates in the world, yet it has a crucial labor shortage—not in unskilled workers, to be sure there are all too many of those around—but in skilled men.

But skilled worker shortages are common to the entire world of metalworking, and Italy is exceptional in that these shortages are the only cloud on the industrial horizon—certainly not enough to impede Italy's ascension into the metalworking sun.

Volkswagen:

How They Do What They Do

The car that forced a revolution in US autobuilding—VW—fits into no standard category, nor do the VW manufacturing plants. In an exclusive interview with American Machinist/Metalworking Manufacturing, Otto Hoehne, production manager of VW, talked on production methods, management, and the VW approach to manufacturing . . .

What makes Volkswagen go so? It certainly isn't the beetle-shaped styling of the Wolfsburg Wonder; nor any air of quiet, luxurious power transmitted to onlookers as a VW zips around a corner. One reason for the world-wide success of the rear-engined small car is Germanic thoroughness, also reflected in VW plants and in VW production planning.

One obvious advantage of the VW is the continuous stream of improvements in the basic car without skyrocketing prices. The recently introduced '61 model, for example, has a new engine, higher compression ratio, automatic choke, synchromesh in all gears, carburetor de-icing, and some twenty-odd other improvements—all at the '60 price.

Admittedly, state ownership of the company puts it into a peach of a competitive position, because profits can be plowed back into the plant, not chopped up among stockholders. This situation may change slightly when, at the first of the year, VW will issue public stock. However, between the Federal German Republic and the state of Lower Saxony, 40% of the ownership will still be government held, and stock ownership by any one person will be limited; therefore government will still control the company.

Result of constant capital reinvestment in the plant is a production layout that would make a Detroit automaker envious. Otto Hoehne, production manager of the company, cited several examples of what has been done to make VW production as modern as any in the world, with a few ideas that are definitely ahead of the field.

Body painting is typical; both technically advanced and cautious. Four coats are applied, the first a dip coat that is baked; the second applied by electrostatic spray equipment built in Germany under license from Rahnsberg in the US. After a second bake, the body is wet sanded and electrostatically sprayed again. Finally, the color coat is added by machine and hand spray guns—to make sure all inside surfaces are covered, too.

Good finishes inside and out are not accidental; VW employs 10% of its production force as inspectors. Although the inspection force tends to think of itself as something apart and quite special, Mr Hoehne adds, "You can't inspect quality into the product; you have to produce quality."

Updated materials

Although the VW engine is small (40 hp) by US standards, it illustrates the latest construction techniques. The four cylinders, with integral air-cooling fins, are cast iron for wear qualities. The cylinder heads are die-cast aluminum (low cost), and the crankcase is a magnesium die casting (light weight). Crankshaft and connecting rods are forged steel.

VW production is growing into a complex. The original plant at Wolfsburg is supported by a Hanover plant that turns out Transporters and engines, one at Kassel for gearboxes and transmissions, and a new one in Brunswick for front axles. The expansion to Kassel was partly a solution to a personnel problem. At Wolfsburg the company has to provide housing for employees; however, the state government of Hessen had requested help in taking up unemployment slack, so new facilities were built at Kassel instead of adding them to Wolfsburg.

Outside Germany, the largest and most complete VW plant is in Brazil, where 90% of each car for the South American market is made. In about a year and a half, VW will stop shipping even the 10% from Germany, and the cars will be 100% built in Brazil.

Americanization

To keep a strong toehold in the US market in spite of the compacts, which have not cut into VW sales so far, the company is starting an Americanization campaign to show how the VW is partly a US product. According to Mr Hoehne, 40% of the body presses in Wolfsburg are US-built, all of the ring and pinion gear-cutting machines are Gleason, and VW buys sheet steel, magnesium, and aluminum from the US. VW is currently giving a tryout to the new Clearing Torque-Pak press clutch, incidentally. Current demands are for 95 tons/day in magnesium and 65 tons/day of aluminum.

Retooling

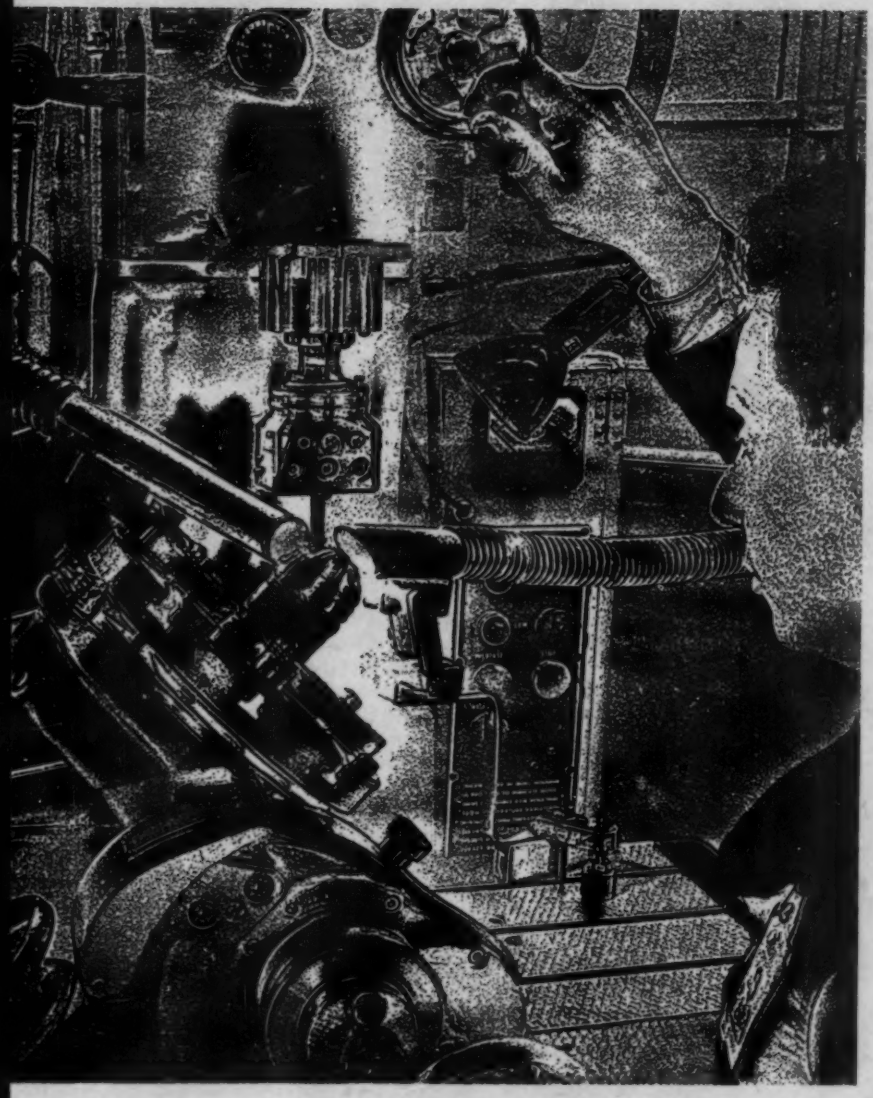
Production planning at VW is a bit different from the same operation in the US. One source of potential product change is the warranty department, where customer complaints are followed. Many of the original weaknesses of the VW were overcome, starting here. Design and production departments also initiate changes; the main requirement being agreement between purchasing, sales, finance, manufacturing, and personnel departments.

Production rate illustrates the cooperation required between departments before any major decision can be made. Production is now being brought up to 4000 cars and Transporters per day. Top management had to agree on that figure, then the production department had to decide what additional equipment was necessary, and submit a list to a committee of department heads; then to a 15-man review board that monitors company operations (from a financial point of view) for the government.

After January 1 '61, (Volkswagen GMBH is already Volkswagen AG), management expects to continue with much the same technique, producing a similar car which, if it changes at all, will still be a rear-engine, air-cooled smallish vehicle intended for as wide a market as possible. VW will be headed by Heinz Nordoff as President, with the directors of purchasing, sales, finance, manufacturing (Mr Hoehne), and personnel acting as a board. In case of a tie vote on a major decision, Mr Nordhoff's vote will have swaying power.

The production man's guide to

WORKING BERYLLIUM



By George A Toczko,
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Beryllium's combination of high melting point, high strength, high elastic modulus, high atom density, and low atomic weight has earned it the title, "wonder metal of the Space Age." This unique metal does seem to have the characteristics to make dreams come true. Despite its limited availability, high cost, manufacturing problems, and toxicity, more and more shops are called upon to work it. Because beryllium is becoming a production metal, we have prepared this report to familiarize you with the latest know-how in working it. This report includes machining, forming, and joining.

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Guide to working beryllium . . .

How to machine beryllium

Although it is more brittle and abrasive, beryllium machines much like cast iron and heat-treated aluminum castings. Coarse-grained cast beryllium and fine-grained hot-pressed beryllium seem to machine alike, except that the cast variety requires more care in handling because of its grain structure and nonhomogeneity.

Chip formation is basically a brittle-fracture process. Chips are partially continuous, consisting of discontinuous segments which reweld after separation. Chips, because they are brittle and easily broken, do not obstruct cuttings.

The machined surface of beryllium looks similar to the tool side of the chips. This scuffed appearance is partially caused by pieces adhering to the built-up edge, which periodically separate from the tool and adhere to the work surface. Surface finish can be improved by increasing the rake angle and by a shallow depth of cut.

Beryllium is susceptible to surface damage, principally cracking, and also is subject to spalling at the exit of cuts. Machining should proceed so that the cut ends at the center of the work—or a backup block of beryllium or other suitable material may be used to continue the cut beyond the piece.

"Different" but not "difficult"—Much has been learned about machining beryllium during the last five years, and many improvements have been made in the machinability of both the sintered billet and the extruded rod. Despite lingering misconceptions, beryllium is a different but not difficult material to machine. Extremely fine surface finishes as well as intricate contours, precision-tolerance holes, and thin-wall sections are being produced almost on a routine basis in many shops.

Many work it now

There are at least a dozen precision machining sources specializing in beryllium end products. Representative of these are such firms as Leemath, Inc, Syosset, L I, N Y; Speedring Corporation, Detroit; American Beryllium Company, Sarasota, Fla.; Alsca Beryllium Machining Corp, Valley Stream, L I, N Y; United States Beryllium Corp, Los Angeles and Pioneer Astrometallics, Chicago.

According to Leemath's Lloyd J Matheson, VP in charge of production, "anything that can be machined in aluminum can be machined in beryllium—provided, of course, that you do the necessary advance planning, methodizing, and proper sequencing of operations. It also goes without saying that you need good tooling, practical jigs and fixtures, good inspection equipment, and—above all—expert machinists who take more than ordinary pride in their work. Actually you can do more machining with beryllium, because you can hold more accurate dimensions and tolerances."

When you are precision machining beryllium, considerable time for in-process inspections should be allowed at every step. These inspections require a variety of precision inspection equipment such as optical comparators, contour analyzers, surface analyzers, compound sine bars and sine plates, Vinco benches for measuring radial angles, electronic gaging devices capable of reading 0.000,001 in. directly, surface plates having flatness within 0.000,010 in., granite parallels accurate within the same limits, optical flats that permit measurements down to ⅛th of a light band, and similar equipment. In addition, X-ray, gamma ray, dye penetrant, and ultrasonic testing permit inspection of rough-finished parts before final machining—to detect incipient flaws and eliminate possible rejects.

Because the physical properties of beryllium make it possible to achieve and hold extremely close tolerances, this high-precision equipment is particularly appropriate in machining this metal. As a consequence, however, the investment for inspection equipment is generally higher for the shop equipped to produce beryllium hardware than for the conventional precision machine shop.

All-beryllium guidance system components have been machined to 0.004 in. wall thickness; holes as small as 0.002 in. have been drilled, and deep-hole drilling to a depth of 30 in. (with 3/16 in. diameters) is no longer an exceptional feat in many shops. Spheres and hemispheres of pure beryllium have been generated with sphericity tolerances of up to 0.000,002 in., and with complex internal geometries formed from solid metal by precision offset boring, drilling, and reaming.

American Beryllium Company cites, as an example, a customer requirement for a flanged bushing to be produced from titanium, because the design criteria called for a lightweight, high-strength material with 0.0002 in. T I R concentricity between OD and ID, and 0.0002 in. total tolerance on ID and OD, with maximum out-of-round not to exceed 0.0002 in. Wall thickness was to be 0.004 in., and flange section finished at 0.011 in. After many attempts, American told the customer that the tolerances could not be maintained in titanium, but that beryllium would do the job in every respect. With customer approval parts were successfully produced from extruded beryllium rod stock. Rejection rate on quantities of 100 was only 1% after the proper methodizing, planning, and tooling had been completed.

A second case history, also from American Beryllium, concerns a customer requirement on a gyro housing, originally to be made from 2017 aluminum, having extremely close ID and OD tolerances, with milled areas cutting through the main wall of support. Even though the material was stabilized with the best known methods available to the industry, the diameter could not be machined within the required tolerances because the milled areas produced stresses affecting the material some days after successful checking. The customer was persuaded to try one prototype made from beryllium, for its extreme dimensional stability. The prototype was successful beyond expectations, and lengthy stabilizing procedures together with many rough-machining operations were eliminated. Parts were held completely within the rigid tolerance requirements and the gyro housing is now being fabricated from beryllium in quantity.

Importance of "Pre-Machining"—At Berylco, the term, "rough-machined blank" has more than the usual significance as applied to conventional materials. Because of beryllium's high cost per pound, the customer is not expected to pay for metal that he eventually must machine away as chips or waste. Consequently beryllium blanks are properly called "pre-machined," in the sense that when shipped to the customer their over-all dimensions and tolerances, as well as contours and configurations, approach as closely as practicable those of the end product.

A second reason for pre-machining to approximately final dimensions is that, in cutting away excess beryllium metal from rod or hot-pressed stock, incipient or potential flaws in the metal can be detected by the producer, and the material returned for remelt or reprocessing. In this way the customer is assured of a higher degree of quality control, and the number of rejects that might appear after his own finish machining is reduced to a minimum.

Berylco's experience indicates that the additional expense to the customer for accurate pre-machining is more than offset by the reduction in finish-machining costs, lowered cost of chip recovery, and the assurance of a better end product, because non-destructive testing (using X-ray, ultrasonics, dye penetrants, etc.) achieves greater precision and reliability as the dimensions of the finished product are approached.

One typical example of the "pre-machining" performed at Berylco is given by this list of specifications recently achieved on an aircraft component for a large manufacturer:

1. Material: metallic beryllium (commercial grade)
2. Purchase as machined blank
3. Fluorescent penetrant inspection per MIL-I-6866 Type I, after rough machining blank
4. X-ray machined blank
5. Determine density for each machined blank (minimum density to be 1.85 g/cc)
6. Vendor to serialize machined blank in numerical sequence; serial number to be engraved or scribed; vendor to prefix serial number with code "Be" for the Beryllium Corporation.
7. Test reports covering chemical analysis, physical properties, fluorescent penetrant inspection, density determination, and X-ray to be supplied by vendor; all radiographs must accompany shipment; all reports and records must be referred to the serial numbers of the machined blanks.
8. Parts require hermetic properties and shall be leak-tight to helium at a rate not to exceed 2×10^{-6} cc/sec; leak test shall be performed on a disk 0.030 in. thick, cut from each end of useful length of rod.

Extruded rod vs hot pressed stock—Although extrusion of rod stock for machining into finished products represents an additional step in the fabricating process, it is often well worth the extra time (and cost) to the fabricator in terms of better machining characteristics, greater strength, and ductility of the metal along the extrusion axis. Part of the superiority of extruded rod for specific machining applications is that the extrusion process causes preferential orientation of the grain structure, reduction in grain size and microstructure, and improved oxide boundaries.

Extrusion also eliminates machining large blocks and the resulting excessive chip accumulation, allowing a decrease in machining costs. Better machinability is attested to by one large beryllium fabricator who prefers to wait four to six weeks for extruded stock made to order by the producer rather than buy "off-the-shelf" hot-pressed billet material pre-finished to size, simply because the extruded rod stock "does a better job in every respect."

American Beryllium Company of Sarasota offers many examples where extruded beryllium was chosen instead of hot-pressed because of the former's better machining qualities and uniform density. One example was a 32-pitch flathead screw with specifications calling for an 8 rms finish and 93% full thread to be burr-free under 40-power magnification. American supplied these screws to specification by single-point chasing them using extruded beryllium bar as the basic stock, whereas an attempt to fulfill this requirement with hot-pressed material was unsuccessful.

Chip salvage—Because of the high cost of beryllium metal—it's about six times that of silver—extreme care must be taken to preserve chip cleanliness and salvage value. **Even slightly contaminated chips undergo a devaluation up to 75% as compared with clean chips suitable for direct reprocessing.** The beryllium oxide content of the scrap also affects its value for reworking.

Devaluation of beryllium chips is introduced by the need for elaborate recovery equipment to remove foreign materials from the chips before they can be reprocessed. Thus, the economic reasons for preventing chip contamination are an added inducement to maintain plant cleanliness and good housekeeping beyond the requirements of safe working conditions. **Where coolants are required as in sawing or grinding (described later), try to select a coolant from which chips and particles can be readily extracted**—often methodizing certain operations "out of turn" to obtain larger-size chips that can be more easily cleaned and thus increase salvage efficiency. Besides the obvious reasons referred to later, cutting tools must be kept sharp to minimize heating the work. Oxide formation on beryllium chips increases proportionately with their temperature.

Most machinists working beryllium avoid using cutting fluids except where necessary, as in grinding, deep-hole drilling, and certain forms of slicing or sawing. Cutting fluids introduce contamination and devaluation of chips, and also make chip collection more difficult. Pneumatic air-exhaust hoses at the work, while primarily used to control the dust hazard within safe limits, also salvage chips and small particles because these hoses convey chips and dust into collection bins from which metal is recovered and reprocessed.

Safety

Elaborate safety measures are being taken to prevent beryllium and its compounds from dispersing into working areas. Recommendations of the AEC for machining beryllium are quoted below from a paper by Breslin and Harris[1] published in 1958 by the Health and Safety Laboratory of the AEC.

"Various machining operations such as turning, milling, drilling, reaming, grinding, and sawing can be successfully performed on beryllium. Precautions are necessary both to secure uncontaminated beryllium chips and to avoid atmospheric dispersal of beryllium particles or dust in working areas. In general, all machining or metal-removal operations should be done under high-speed air-exhaust equipment adapted to the operation. For all machining operations performed without an exhaust system[2], a coolant such as any ordinary soluble oil or cutting fluid should be used, primarily to suppress metallic dust and secondarily to cool the work and wash away chips if necessary."

"Carbide-tipped tools are generally used for turning, milling and drilling operations. The actual cutting speeds are determined by the capacity of the exhaust system and the method of collecting chips. At excessive speed, chips from these

[1] *"Health protection in Beryllium Facilities — Summary of Ten Years of Experience,"* by J. A. Breslin and W. B. Harris, U. S. Atomic Energy Commission, May 1, 1958.

[2] Author's note: Berylco's experience indicates that in many shops this hazard is avoided simply because no machining operation is performed without an exhaust system. Even in "wet" operations where copious flow of coolant causes a problem, additional separation equipment is installed to recycle the coolant and remove particles of beryllium dust.

operations break into small pieces which may be thrown beyond the capture area of the exhaust hood. It is essential that all grinders be properly hooded for efficient air exhaust to remove airborne dust not carried away by the coolant. Sludge which collects under the liquid in the pit or on machine surfaces should be removed frequently to prevent the health hazard created when it dries out and becomes airborne."

Additional Precautions—Some of the precautions being taken by companies currently machining beryllium include the following, according to the Defense Metals Information Center (Battelle Memorial Institute) report of June 5, 1959:[a]

1. An enclosed area reserved for machining beryllium in which walls, floors and machines are coated with glossy paint to minimize dust adherence and to facilitate cleaning. Central-type vacuum cleaners are used to clean spills and walls; floors and other surfaces are washed periodically.
2. Facilities which allow personnel to remain in the shop building for an entire workshift, to prevent random scattering of beryllium dust to noncontrolled areas.
3. Pre-employment examination and periodic control examinations of personnel with emphasis on the respiratory system.
4. Various rules for the protection of personnel on the job, depending on the degree of hazardous exposure, including use of protective clothing, on-site laundering of same, shower facilities between "contaminated-clothing area" and locker room, and protective clothing for visitors, maintenance personnel, and others entering the machining area on an occasional basis.

Skin cleaning and inspection

The hot-pressed billet is coated with a thin crust of beryllium oxide, graphite, and other impurities. This crust must be removed before heavy machining of the metal can begin. A cut about ⅛ in. deep is made, usually on a vertical turret lathe, at a speed of about 200 spfm and a feed of 0.005 ipr. The operation is essentially that of turning.

This preliminary skin-cleaning operation makes it possible to inspect the sintered billet with X-rays or gamma radiography, Magnaflux, ultrasonics, Zyglo chemical developer, dye penetrants, and similar tests.

[a]Abridged from DMIC Report June 5.

Table 1—Tool Design for Lathe Operations

Tool geometry	Turning	Forming
Back-rake angle, degrees	0	+8
Side-rake angle, degrees	7 to 8	None
Side-cutting-edge angle, degrees	12 to 15	None
End-cutting-edge angle, degrees	8 to 15	None
Side-relief angle, degrees	7 to 10	7
End-relief angle, degrees	7 to 10	7
Nose radius (continuous cutting) in.	1/64 to 1/32	None
Nose radius (interrupted cutting) in.	1/16	None

Table 2—Speed, feed and depth of cut for lathe operations

Speed, fpm	150 to 250
Feed, ipr	0.005 to 0.015
Depth of cut, in.	to 0.100
Horsepower	1 hp per cu in. per min

Speed, feed and depth of cut used in lathe operations with beryllium, are comparable to those used for cast iron. However, lower speeds are necessary for clean chip salvage and efficient dust removal..

Lathe operations

Beryllium metal readily lends itself to machining on conventional lathes. The machinability of beryllium permits speeds and feeds similar to those for cast iron, although the actual cutting speed must not exceed the capacity of the exhaust system and chip-collection system. Accordingly, lower speeds are usually mandatory for clean chip salvage and control of dust hazards. Rate of scavenge is frequently the criterion.

Turning—Beryllium can be turned with either high-speed steel or carbide-tipped single-point tools. High-speed steel tools are not recommended because of excessive tool wear. For best results carbide Grade C-1 or equivalent should be used for roughing and interrupted cuts, and carbide Grade C-2 for finishing, to obtain longer tool life.

One difficulty common when turning beryllium is that the metal tends to chip or break off when the tool leaves the cut. This spalling may be overcome by chamfering both ends to the finished diameter before turning. An alternate method is to finish-turn one end for a short distance, reverse the ends, and then finish-turn the remainder. In both instances, light finishing cuts not exceeding 0.015 in. deep should be taken. When the metal is turned on centers, use live centers because beryllium is highly abrasive to all tooling.

Threading of beryllium can also be done on a lathe, using a single-point tool. Dies and chasers are not recommended, because the beryllium breaks off into small pieces and jams into the tool, causing torn threads and excessive tool wear. The lathe compound should be set at one-half the included angle of the thread to achieve the effect of a side-cutting tool.

Tool materials—As previously noted, high-speed steel tools are seldom used for machining beryllium because of the excessive tool wear. Instead, carbide tools are used, giving a tool life far better than that obtained when machining titanium, and comparable to the tool life when machining carbon steel. The wear land on the clearance face of the tool grows uniformly, and wear on the cutting face (cratering) is not severe.

Carbide tools should be resharpened as soon as they become slightly dull. Maintaining good cutting edges will help conserve tool material and minimize the possibility of heat checking. Sharpen the edges on 320-grit silicon-carbide wheels, or on 200- to 300-grit diamond wheels. Hand stone the edges after sharpening. Tooling costs and resharpening costs are always high for machining beryllium.

Table 3--Tool design for milling

Tool geometry	Rough and finish milling
Back-rake angle, degrees	0 to 10
Side-cutting-edge angle, degrees	7
Face-cutting-edge angle, degrees	3 to 7
Side-relief angle, degrees	10 to 15
End-relief angle, degrees	10 to 15
Land, in.	1/32 to 1/16

Tool design—Proper rake angles promote free cutting and maximum tool life. Excessive rake angles must be avoided, because contamination by tool breakage decreases the scrap value of beryllium chips. Grind a large side-cutting-edge angle on the cutting tool to be sure that the impact load will occur at a point back of the nose. This angle will also ease the tool out of the cut at the end of the piece. Excessive angles, however, will cause chatter. End-cutting-edge angles should be large enough to allow the tool to clear the work and thus preventing rubbing. Nose radius should be small (1/64 to 1/32 in.), and should be omitted when a heavy cut is to be taken.

Feeds should not be over 0.015 in. per revolution to prevent rough finishes and "breakouts" on edges. Extremely fine feeds also should be avoided, as these tend to dull the tools faster and heat the work more than heavier cuts. Critical inspection for surface cracks will help you.

Tracer equipment on engine lathes is coming into increasing use in machining beryllium. This equipment consists of a hydraulic or electronic tracer positioned to actuate the cutting tool to follow, with great precision, the track of a stylus along the contours of a master model or pattern, made of aluminum, magnesium, steel, or thermosetting plastic.

Tracer equipment is important because complex shapes and geometries cannot be obtained in beryllium through the usual methods of casting, forging, coining or extruding, but require machining of various types. With tracer equipment, a fabricator can achieve quantity production of beryllium hardware on conventional engine lathes without loss of reproducibility. This means he can maintain precise dimensional tolerances over long runs, approaching semi-automatic operation, without appreciable increase in capital investment.

Milling

Milling beryllium loosely follows the practice used in turning. Conditions and techniques regarding safety, grades of cutting tools, chipping of work, speeds and feeds are similar for the two methods of machining. **Conventional milling, rather than climb milling, is recommended to produce the best finish with the most economical use of cutters.** Because beryllium tends to chip as the cutter leaves the work, some suitable backup material (such as free-cutting steel) should be used. Iron or steel chips can then be readily removed from the beryllium by magnetic separation.

Tool materials—Carbide cutters are recommended for milling beryllium for the same reason that they are used for turning operations. Inserted carbide tooth cutters of Grade C-1 carbide are used for rough milling; carbide Grade C-2 for finish milling.

Chemical milling—Milling beryllium by precisely controlled chemical erosion is still in the development stage, but it shows considerable promise as a solution to the problem of reducing extremely thin surface areas after conventional milling has been performed. It is also used to remove surface oxides and other impurities. Chemical milling has proved its efficiency on parts where either fragility or massiveness, or both, preclude the use of conventional milling.[4]

Drilling and reaming

Drilling holes to depths less than five times the diameter is considered "conventional" drilling; of holes that exceed five times the diameter, "deep-hole" drilling. Because of its hardness and its tendency to seize iron and steel, drilling beryllium calls for considerable care and experience. It may be necessary to change drills several times in a single hole, especially in deep-hole drilling. When holes are drilled through, the material around the hole exit may spall as the drill breaks through. A backup plate or block of beryllium or steel often eliminates this problem. Steel chips then can be separated from the beryllium by magnetic separation. (Deep hole drilling is considered in a separate paragraph.)

Reaming produces a hole having accurate dimensions and a fine finish. The stock left after drilling depends on the finish required, the depth of the hole, and the chip capacity of the reamer.

Tool materials—Solid carbide or carbide-tipped drills are recommended for major drilling operations. When these are not available, high-speed drills can be used for limited applications. A 90-degree included angle is used for both carbide and high-speed steel drills.

[4]For further information on chemical milling, see R. E. Samuelson, "Chemical Milling" ASTME Paper delivered at Philadelphia, Nov., 1959.

Table 4—Speed, feed and depth of cut for milling

	Roughing	Finishing
Speed, fpm	60 - 100	100 - 150
Table feed, ipm	3 - 6	3 - 6
Depth of cut, in.	No data	No data

Speeds used for milling beryllium must be selected on the basis of efficient chip disposal and minimum airborne dust as well as the size of the piece, rigidity of setup, and depth of cut. (The Atomic Energy Commission recommends that airborne dust be less than 2.0 micrograms per cubic meter, although recent evaluations of several years' data indicate this value may be overly conservative.)

For example, using a 6-in. face milling cutter with ten carbide-tipped inserted cutter blades, for a flat surface of average size firmly held in a vise, take the rough cuts at spindle speeds of from 60 to 100 sfpm, raise the speed to 100-150 fpm for finishing cuts. Use table feeds of 3 to 6 fpm for roughing and about the same for finishing cuts. If a large amount of beryllium is to be removed, it may be more profitable to machine without cutting fluids of any kind, assuming an adequate exhaust system. At lower volumes, ordinary soluble oils or emulsions may be used, 1 part oil to 20-30 parts water.

Some beryllium fabricators today are successfully drilling holes as small as 0.002 in. in diameter. Holes under 0.065 in., however, usually present considerable difficulty. Standard drills do not cut, even when the thrust forces are high enough to buckle and break the drill. The web seems to wear, flatten and grow—consequently little or no cutting action results. Reducing the point angle from the 118- or 135-degree value to 90 degrees, and the web thickness to 0.015 or 0.020 in., will help produce a satisfactory cutting action. The same factors governing cutting fluid use apply here as were outlined previously.

Table 6—Stock allowance in reaming

Diameter of hole, in.	Stock allowance, in.
¼	0.006
½	0.010
1½	0.060

An allowance of 0.001 to 0.003 in. is common practice for hand-reaming operations. Speed of reaming is controlled by the rigidity of the setup, and by the tolerance and finish required. Excessive speeds can cause chatter, harmful to both reamer and finish. Speeds commonly used are about two-thirds of those listed under drilling.

Table 5—Speed, feed and depth of cut for drilling

Drill size, in.	Speed, fpm	Feed, ipm
Under ⅛	70 - 100	0.001 - 0.002
¼	70 - 100	0.002 - 0.004
½	70 - 100	0.005

Deep-hole drilling

Deep-hole drilling of beryllium is extremely difficult and calls for specialized techniques, including using cutting fluids under pressures up to 3000 psi and special oil-hole drills or rifle drills. These pressures require oil pumps as large as 50 hp. In fact, one fabricator claims that the only limit on deep-hole drilling beryllium is the amount of oil pressure that can be economically made available. We have drilled 0.250 in. dia up to 32 in. deep.

One of the difficulties of deep-hole drilling is that as the heat of cutting accumulates in the drill and in the work, the drill may expand more than the hole, eventually causing the shank to rub against the wall of the hole. This in turn causes more heat and binding, until seizure and drill failure occur. With certain modifications in drill and tool-holder design, however, deep holes (over five diameters) can be successfully produced, using either a standard drillpress or a deep-hole drilling machine. Pieces too large to rotate in the latter, or beyond the range of a drillpress, can be drilled on a modified engine lathe.

Tool materials and design—In deep-hole drilling, the standard drill design is a two-flute, oil-hole drill, carbide-tipped, with its point ground to a 90-degree included angle. Drill shank should be undercut 0.010 in. on the diameter behind the carbide tip, which should back taper 0.004 in. per in. Primary clearance angle should be increased to about six degrees.

Special toolholders help minimize drill breakage. The drill can be held in a revolving socket located in the toolholder, and the socket collar provided with a single cam which rests on a spring-loaded lever attached to the face of the toolholder. The spring is adjusted to a tension sufficient to hold the drill in place against normal machining pressure. If excessive pressure occurs, the cam trips the spring lever and permits the drill socket to rotate freely in the toolholder.

Another possibility for guarding against drill breakage is to install a miniature strain gage on the shank of the drill.

Rifle drills—The second design of drill used in deep-hole drilling beryllium is a single-flute carbide-tipped rifle drill. The shank is a seamless-steel tube having a diameter slightly smaller than the top and brazed to the tip. One side of the tube is depressed to form a V groove, which extends the entire length of the shank to the point of the drill, and is continued to the drill point by removing about a third of the cross-sectional area of the tip. One or two holes (about 1/32 in. dia) are drilled longitudinally through the tip just below each outer corner of the "V," to provide for the outlet of coolant from the hollow shank in the cutting site. This V groove permits the outflow of the chip-laden coolant from the cutting site. Longitudinal clearance is ground along the tool body to reduce friction and to allow coolant flow around the tip into the V groove.[5]

One cutting edge is located on an outside corner of the V, while the other is formed by the adjacent edge of the V along the face of the tool extending to the center of the drill. The cylindrical tool body immediately behind the cutting tip bears on the finished surface of the hole to guide the point into the work. On 3/16 in. drills, the guiding elements of the tip consist of a cylindrical land 1/64 in. wide, located below the cutting edge, and a bearing surface 7/32 in. wide, located diametrically opposite to the land.

The drill face is ground so that a line along the cutting edge in the V makes a 15-degree angle with the drill's cross-section, and with any line on the face perpendicular to the axis of the drill. Thus the face recedes from the point and from the cutting edge of the drill on a compound angle which forms a 15-degree side-cutting angle and a 15-degree shear as it enters the work. A second clearance is ground around the coolant hole on the lower side of the drill face, to allow larger space for flushing chips from the cutting site. This clearance is bounded by a line passing slightly off-center between the coolant holes, the lower edge of the V and the periphery of the drill.

Electrical discharge machining

Drilling and machining by electric spark are coming into wider use among producers and fabricators of beryllium, molybdenum, and other exotic metals. In this process, the

[5] A different type of rifle drill made by El Dorado Tool and Mfg. Company has only one longitudinal hole.

Table 7—Speed, feed and depth of cut for deep-hole drilling beryllium

Drilled hole Diameter, in.	Depth, ft	Speed, fpm	Feed, ipr
⅛	2 - 3	70 - 100	0.0004

Speeds, feeds and depth of cuts for deep-hole drilling with conventional twist drills in drillpresses, deep-hole drilling machines, or engine lathes.

Recommended drilling speed of 70 to 100 sfpm using carbide drills, applies for deep holes as well as for shallower ones. However, in deep-hole drilling beryllium the feed rate is reduced; for holes 2 to 3 ft deep, the feed rate should be 0.0004 in. per revolution for a ⅛-in. dia drill. This rate is increased proportionately with larger diameter or reduced depth. Coolant used for deep-hole drilling is usually commercial-grade kerosene, under a pressure of at least 200 psi, although much higher pressures are often used.

work is the anode and a spark is created between it and the cathode. A pulsating d-c current is used with a dielectric which is a moderate conductor, or even a poor conductor of electricity, such as a light oil. The Beryllium Corporation, in collaboration with the Cincinnati Milling Machine Company, has developed a low-density tungsten compact infiltrated with silver as an electrode material, which has proved best so far.

The process works in this manner: A rapid succession of sparks of high-current density (10^6 amp/sq in.) creates a kind of "tunnel" in the dielectric (light oil), the latter controlling or resisting the expansion of the resulting gas bubbles and confining the arc to a predetermined diameter. The frequency (or rate of pulsation) of the d-c current is on the order of tens of thousands of "sparks" per second, each of which lasts about 10-30 microseconds, to erode away the metal.

Electrical - discharge machining has several unique advantages. First, it results in a saving of material, hence cost, on specialized applications. Second, it succeeds in drilling or otherwise perforating beryllium in complex or irregular forms or cavities (star-shaped holes, hexagonal, and other regular or intricate configurations) of extremely small or very large diameters that cannot be machined by other techniques currently used on beryllium metal.

Trepanning

Beryllium producers have been forced into some unusual trepanning and parting operations because of the nature of the product and its current fabricating process. Over 90% of the finished parts are machined from hot-pressed billets which, as pointed out earlier, are for the most part limited to solid cylinders, blocks and slabs. Whereas in other metals one could start with castings, forgings, wrought and formed shapes, etc., in the production of hollow ware—in the beryllium industry this is not yet the norm.

The value of the metal dictates that solids rather than chips be salvaged wherever possible because secondary products can often be machined from such end stock. Accordingly, holes over two inches in diameter are usually trepanned. This need has resulted in the development of some interesting tooling to effect conical and spheroidal trepanning in addition to plain cylindrical work. In general, trepanning tool design must be a compromise between rigidity of the tool and narrowness of the kerf.

In other than straight cylindrical cutting, this compromise often means a multiplicity of parting blades, each working to progressively deeper depths, and also to complicated follower-rests designed to strengthen the tool and minimize chatter. Despite the need for such highly specialized tools, the cost of tooling, together with the actual cost of the trepanning operation itself, is generally quite unimportant when the value of the salvaged beryllium metal is considered.

Trepanning case history—To produce a truncated conical shape in beryllium by trepanning, the Beryllium Corporation recently designed and built a special tool which would feed into the work at an angle of approximately 16°. The unique problem solved here is that the diameter of the kerf had to diminish at a uniform rate, yet with minimum width of kerf—to preserve intact, as a solid piece of beryllium, the core material in the truncated cone. Shapes of this type have, of course, been fabricated in beryllium by using thin-gage rolled beryllium sheet, forming into the cone shape, and welding along one or two seams. However, because of the present state of beryllium welding, the resulting product is limited both in wall thickness and in wear strength because of the possibility of weld cracking. The material on the "outside" of the trepanned cone is kept to minimum volume because the resulting shape is not usable except for reprocessing.

The clearance angle in trepanning increases sharply as the hole diameter diminishes. For this reason, the clearance angle must have a correctly designed outside edge to give optimum cutting (hence rigidity and sharpness) as well as minimum kerf (which represents scrap or waste metal). In other words, the tool design must accommodate constantly diminishing (or increasing) diameter of the cut, because frequently the trepanned hole is formed from both ends of the original block, much in the same manner as tunnels are excavated from both ends, but for quite different reasons.

Grinding

Grinding beryllium is necessary only on shapes that require sharp edges and close tolerances, and where a few thousandths of an inch of material is to be removed. Grinding is usually unnecessary because finishing cuts by machining will give the required finish if the tools used are in good condition.

For rough grinding, coarse-grained aluminum-oxide wheels with a soft-grade vitrified bond are used; for fine finish grinding, wheels of medium grain and medium hardness are recommended. All grinders should be properly hooded for removal of airborne dust via the pneumatic system. Cut-off wheels range in size from 6 in. x 0.030 in. to 14 in. x 0.075 in., with operating speeds as recommended by the maker.

Parting or slicing

Parting or slicing of the cylindrical, rectangular or hexagonal sintered pressing into workable sizes is essentially a cutting or sawing operation. Billet slicing in large diameters and lengths—up to 36 in. both ways—has represented, in recent years, a vast improvement over earlier techniques that required many separate furnace operations to produce a number of smaller billets. A single large billet that can be

sliced to make various rough-finished smaller parts requires less skin-cleaning and fewer furnace hours than the equivalent weight of smaller billets.

A bandsaw must be used for slicing hot-pressed billets having work heights as high as 36 in. Because of the value of the metal, the allowance for kerf must be held to an absolute minimum and bowing or "wandering" of the bandsaw rigidly controlled. To meet these requirements, Brylco has equipped its large bandsaws with strain gages on the posts immediately behind the saw guides. These strain gages are installed in pairs—one on the saw centerline, to detect bowing either to left or right before the work can be damaged—bowing being normally the result of inadequate tension or preferential wear on the band teeth.

The strain gage that measures cutting force actually controls the rate of cut, as Berylco establishes no arbitrary rate of feed, but rather selects optimum cutting force for a particular work height. A limit switch on the strain-gage indicator automatically stops the machine before the cut is permitted to wander. Thus strain gages serve two distinct functions: They warn of incipient bowing, and they indicate the cutting force required—the latter being a reliable index of cutting efficiency. Strain gages also serve as a functional inspection of the band before cutting begins, detecting camber, cross-sectional bowing and any "dog-leg."

Beryllium can be easily sawed or sliced with a bandsaw, using a claw-tooth blade 1 in. wide, 6 to 10 pitch, 0.040 gage and 0.060 in. set for work up to 3 in. thick. For work above 3 in., a claw-tooth saw, 2 in. wide, 2 pitch, 0.050 gage and 0.060 in. set is recommended.

Table 8—Saw speeds vs thickness

	Work height, in.	Band speed, sfpm	Feed sq. in./min.
1-in. saw	⅛ - 1	150 - 100	15 - 10
	1 - 3*	100 - 85	10 - 5
2-in. saw	3 - 6*	150	10 - 7
	6 - 10	150	7 - 4
	10 - 20	145 - 125	2 - 1
	20 - 30	125 - 112	1½ - 1
	30 and over	100 - 95	less than 1

*The apparent inconsistency in the band speeds for the 1-3 in. and 3-6 in. range of work heights in this table is explained by the additional beam strength afforded by the 2-in. blade, and also because this blade can be accommodated only on a machine of the bandmiller type, which provides for greater rigidity in addition to positive table feed.

How to form beryllium

For rolling, forging, forming or extrusion, beryllium is generally worked hot (above 1400 F), with the metal clad in a mild-steel can, or jacket, covered with a protective coating or handled under an inert atmosphere.

Rolling

Hot - pressed compacts, because they have essentially isotropic mechanical properties, make excellent rolling material. The mild-steel can or jacket serves the triple purpose of reducing the oxidation of the work in hot rolling, of acting as a lubricant, and of acting as a thermal barrier to prevent chilling the beryllium.

(Alternate . . . rolling material. Extruded beryllium flats and warm-pressed beryllium have also been used. A mild-steel can or jacket serves the dual purpose of reducing the oxidation of the work in hot rolling and of providing edge restraint to reduce the tendency for cracking.)

Sheet rolling is approaching commercial reality, although consistency of texture, properties, and tolerances are still problems. Sheets as large as 30 in. by 60 in., in thicknesses down to 0.020 in., have been produced. This form of wrought beryllium is under intensive study to provide sheets on a consistent basis in the near future.

Forging

Hot-pressed and rolled and extruded and rolled beryllium have been used for die forging and hot coining. As before, steel jackets are widely used, to give lateral support during the forging operation and thus prevent edge cracking which causes a loss of metal. Beryllium has forging characteristics similar to those of magnesium. Forging perpendicularly rather than parallel to the extrusion axis gives best results.

Forging conditions such as temperature, rate of deformation, etc are still under active investigation, although certain parts have been successfully produced starting with hot-pressed billets or with powder. This process should help to provide economies in fabrication costs because it eliminates the standard hot-pressing cycle normally used to produce the starting billets, and because forging will often lend itself to producing parts nearer to final shape — thereby reducing scrap losses. At the same time, it is expected that mechanical properties superior to those of the hot-pressed product will result.

Extrusion

Extrusion offers an attractive means of fabricating beryllium. Extrusion of rounds, squares, and rectangles is a commercial process at Berylco, and experimental work is being performed to extend the product line to tubing and other more complex shapes. Two distinct advantages will result when beryllium is extruded—higher strength levels than most other forms of the metal, and greater economy as a result of yield from starting billet to finished stock when compared to the more common method of hot-vacuum pressing and machining to the desired shape.

Successful extrusion of more com-

plex shapes will require further process refinements, as it still is necessary to extrude beryllium encased in a steel jacket—bare extrusion of beryllium shapes being for the most part unsuccessful in providing good surfaces, acceptable dimensional tolerances, and high mechanical properties. As in rolling, jacketing serves various purposes: (1) It acts as a lubricant (because beryllium readily seizes and galls tools), (2) It helps to keep the beryllium in compression, (3) It prevents excessive oxidation during heating and extrusion, and (4) It retains heat.

Commercial extrusions are made from hot-pressed beryllium billet, because of the latter's finer grain size and better mechanical properties as compared with cast billets. The jacket is made by spinning a seamless steel tube closed on one end, forming a 45° angle. Billets are heated in a conventional furnace with the jacketed billet positioned inside a graphite sleeve and cover to prevent oxidation. Temperature range is 1750 to 1950 F.

In extrusion, time and temperature control are highly important. Transfer time from the furnace to the extrusion liner may be minimized so that the actual extrusion temperature can be conrolled within narrow limits. As a rule, some straightening is required on all extrusions, using conventional straightening procedures. Rod sizes range from ½ to 4 in. in diameter. The surface finish of the as-extruded material has a thin oxide coating, and while the surface finish is better than 63 rms, common practice is to take a light machine cut to give a better finish and to meet the various size requirements.

Quality-control procedures include cutting tensile bars from various locations to insure high uniformity throughout the extrusion. Uniformity of tensile properties depends somewhat on the reduction ratio; The Beryllium Corporation metallurgists specify minimum reduction ratios of about 8 to 1 to insure high properties and a uniform product.

One interesting application for beryllium extruded rod is in the production of beryllium fasteners. The Standard Pressed Steel Company of Jenkintown, Pa., in its work on Air Force Contract AF 33 (600)—39728, reported success in manufacturing beryllium bolts with rolled threads. The material supplied for this important research program tested at 97,600 psi ultimate tensile strength, 46,500 psi yield strength, with 11% elongation.

How to join beryllium

Shrink fitting beryllium parts together by expanding the outer member through heat to increase its diameter so that the inner member can be put in place, is the commonest form of joining beryllium in final assembly. On cooling, the outer member contracts and holds the two pieces together. The same effect may be obtained on small work by cooling the inner member with dry ice and alcohol instead of heating the outer member.

Fusion welding

Most fusion welding of beryllium, using berylium as a filler material, is done with a tungsten arc and an inert-gas shield, usually argon or helium. Best results are obtained with straight polarity and direct current. Beryllium rods, both bare and coated with Alcoa 27 flux, have been used. Bare rods are the more satisfactory. Work on this phase of joining is progressing, and—according to engineers of The Budd Company where much research on the welding of beryllium is being conducted—crack-free welds have been produced on a limited scale, although the process must be further refined before being adaptable to volume production.

Budd research

The Battelle Memorial Institute states that fusion welding of beryllium does not yield satisfactory joints because of the large grain size and other physical properties of the as-cast material, but adds that continued research should produce considerable improvement in this method of joining beryllium. Metallurgists at Budd have produced crack-free welds by this method which have stood up under long periods of accelerated wear-testing.

Diffusion welding or self-welding

Pieces of beryllium, held in close contact for from one to several hours at temperatures from 1650 to 2280 F (below the melting point of 2345 F) will join (weld) through a combination of mechanisms. Such "self-welds" can be made either in vacuum or in an atmosphere of purified argon; to date, better results are obtained in vacuum.

Braze welding

To braze weld beryllium, aluminum brazing alloy containing a small amount of silicon is used either as a separate filler or as the welding electrode, with either an arc or an oxy-acetylene torch. A consumable arc and inert-gas shield yields better braze welds than covered-electrode or tungsten-arc welding. Porosity in the weld, however, is still a problem that has not been entirely solved. Successful braze-welded joints have strengths equal to that of the aluminum filler material.

Furnace brazing

Best materials for joining beryllium to itself by this process are aluminum, silver, lithium, and aluminum-silver or silver-copper eutectic alloys. Copper has also been used to join beryllium to other metals such as nickel, stainless steel, and copper itself. The process is limited to simple shapes, and as the name implies, requires an electric furnace. Lap joints, step joints, scarf joints, and butt joints can be made by this method. However, holding time and temperature are critical factors. For aluminum as braze material, optimum temperature seems to be about 1500 F, with holding time somewhere between 1 and 3 hours—or before the aluminum migrates away from the joint and thus forms voids at the interface.

Brazing with silver and silver-copper eutectic alloys does not cause the "migration" problem. The joint is held at temperature long enough for the brazing material to melt and flow properly. Beryllium may be brazed to itself or to nickel, Monel, or copper—either in a vacuum or in an atmosphere of hydrogen or inert gas. For brazing to stainless, dry hydrogen must be used.

More on Beryllium

Control beryllium dust	*Jan 11 '60, p86*
Machining	*July 13 '59, p171*
Billet slicing	*July 13 '59, p103*
Shop to work	*July 13 '59, p116*
How to machine	*April 21 '58, p129*

Background on beryllium

Comparable to steel on a strength-to-weight-ratio basis, yet lighter than aluminum, with an extremely high melting point (2345 F) combined with excellent thermal conductivity, nonmagnetic yet a good conductor of electricity, beryllium possesses a unique combination of properties that has widened its use far beyond the atomic applications which provided the impetus for quantity production in 1951.

The density of beryllium is 0.066 lb/cu in., virtually the same as magnesium's which is 0.063. However, beryllium's modulus of elasticity is approximately 42 x 10^6 psi, which is nearly 40% higher than that of alloy steels and 150% greater than that of titanium. Its high strength to weigh ratio and thermal conductivity have made it highly important in the design of aircraft and missile structures.

Beryllium retains approximately 50% of its yield strength up to 1000 F and resists excessive oxidation up to 1400 F. Chemically similar to aluminum (but lighter and vastly stronger), beryllium forms a protective oxide skin from which it derives its stability in air at temperatures up to red heat.

Table 9—Physical properties of beryllium

Atomic number	4
Atomic weight	9.02
Density (gm/cc)	1.85
Density (lbs/in.^{3})	0.066
Electrical conductivity (% IACS)	40
Electrical resistivity (microhms/cc)	3.9-4.3
Electrode potential (volts)	—1.69
Melting point (C)	1285
(F)	2345
Boiling point (C)	2970
(F)	5378
Linear coefficient of expansion	
25-100 C	11.5 X 10^{-6} in./in./°C
25-300 C	13.4 X 10^{-6} in./in./°C
25-500 C	14.5 X 10^{-6} in./in./°C
25-700 C	15.6 X 10^{-6} in./in./°C
25-900 C	17.0 X 10^{-6} in./in./°C
70 F	6.4 X 10^{-6} in./in./°F
1200 F	12.4 X 10^{-6} in./in./°F
Thermal conductivity at 20 C	
(Cal/sq cm/cm/cm/sec/°C)	0.385
(BTU/ft/ft^2/hr/°F at 70°)	87
(BTU/ft/ft^2/hr/°F at 1200°)	65
(Barns/atom)	0.0090
(% of Cu)	42
Specific heat, at 20-100 C	
(Cal/gm/deg C)	0.43-0.52
(BTU/lb/°F)	0.43-0.52
Latent heat of fusion (Cal/gm)	250-275
Magnetic susceptibility (Gauss/oersted c g s)	0.79
Thermal neutron absorption cross section	
(Barns/atom)	0.0090 ±0.0005
Velocity of sound (ft/sec)	41,300

Shortcomings of beryllium

Today's "wonder metal" may well be the most promising structural material of the Space Age, but it has a few shortcomings, some of which will disappear as demand and quantity production are stepped up, while others may have to await more intensified research and development.

Cost

Beryllium is an expensive metal, costing between $70 and $100 a pound, depending on the form and purity of the product. Obviously chip and powder recovery, up to 100%, is vital to economically machining beryllium. Chip cleanliness is essential to maintaining maximum salvage value. Fabricators generally avoid using cutting fluids to prevent chip contamination and subsequent devaluation (to as low as 25% the value of clean chips).

Considerable reduction in cost is expected during the next few years if present predictions of volume increase come true. Cost will be further reduced as improved methods of fabricating—by casting, forging, extrusion and rolling—are developed. Even today, however, beryllium is commercially available at prices competitive with other metals where weight and strength are prime considerations or where high temperatures are encountered.

Toxicity

Safe handling and machining of beryllium depend on rigid control of dust, fumes, and chips. Toxic effects are manifested in lung disorders (berylliosis or chemical pneumonitis), dermatitis, or skin ulcers caused by implantation of beryllium chips in or under the skin. The bulk material or finished product, however, can be handled without hazard to the worker.

The AEC has established maximum allowable concentrations of beryllium in the atmosphere as standards of safety for persons in and around beryllium plants. Since these were established in 1948, experience has demonstrated that toxic effects of beryllium can be effectively controlled by an integrated program of medical, personal hygiene, and industrial hygiene. It has been demonstrated repeatedy by producers, precision machining companies, instrument manufacturers, aircraft companies, and others who

have long handled beryllium in their plants that a safe operation can be maintained with reasonable diligence.

Brittleness

A third problem area is beryllium's brittleness, or lack of ductility. Lack of ductility prevents the economic quantity fabrication by conventional metalworking techniques. Hot working, including extrusion from –200 mesh powder, has produced ductilities up to 20% elongation, together with greatly enhanced mechanical properties resulting from preferred grain orientation in the direction of extrusion. Beryllium sheet, fabricated by extruding flats and rolling perpendicular to the direction of extrusion, has produced ductilities up to 30 to 40% elongation in the plane of the sheet. These are tremendous improvements over the earliest forms of beryllium rods which had essentially zero ductility. Much research is currently being conducted in this area. Lack of ductility, however, has not precluded the development of beryllium for use in structural parts, inertial guidance systems, beryllium aircraft fasteners, and missile nose cones.

Ore supplies

The availability of beryllium ore in face of a rapidly increasing demand is another problem. In 1959, U. S. consumption of beryl ore alone was about 8,000 tons — more than 60% of the total world supply of 13,000 tons for 1956. Brazil, Mozambique, Argentina, Congo, India, and South Africa are the principal sources of beryl ore—in that order. The United States, despite deposits of some 300,000 tons of beryl at Kings Mountain (North Carolina) in the form of as yet unrecoverable spodumene pegmatite, is largely dependent on foreign sources. The industry is confident that substantial increases in the supply will be made available as uses for beryllium metal develop. Recent explorations in the western part of the United States indicate that much larger deposits of beryl may soon be available to provide a more plentiful domestic supply than previously anticipated.

History

Discovered as early as 1798 by the French chemist Vauquelin and named "glucinum" (or glucinium), because its soluble salt had a sweet taste, beryllium was first prepared in highly pure form (99.5 to 99.8%) by another Frenchman, Lebeau, but only on a laboratory scale. **It was not until 1916 that Hugh S Cooper, in the United States, produced the first sizable ingot of beryllium;** in 1919 its outstanding properties were first described by J S Negru, then editor of McGraw-Hill's *Chemical and Metallurgical Engineering*. The discovery by Corson in 1926 of beryllium's ability to age-harden copper was commercially developed by the German company Siemens and Halske, and in 1929 the Beryllium Corporation was formed at Cleveland. **The first significant domestic production of beryllium copper was at Beryleo's Marysville (Mich) plant.**

Growth of the beryllium industry began in earnest with the development of the U S Atomic Energy Program. Beginning with its use as a reflector in the Materials Testing Reactor at the AEC's National Reactor Testing Station in Idaho (erected in 1950), beryllium's combination of high atom density and low atomic weight with low absorption cross section has made it the only metallic element suitable for a moderator and one of the best materials for use as a neutron reflector. In 1951 the AEC first established facilities to produce beryllium metal in volume, boosting production from several hundred to approximately 40,000 lb annually. In late 1956, the AEC contracted with two private producers for a total of 200,000 lb annually for five years beginning in 1958.

During the period 1949-1959, industry sales (including beryllium alloys) increased from $6.6 million to $37 million. The recent spurt in beryllium usage is emphasized by the sales during the the last two years. In 1959 industry sales totalled $37 million compared to $27.5 million in 1958—an increase of approximately 34% in one year. Industry is predicting a similar percentage increase for 1960, principally in pure beryllium.

Each of the two producers employs different extractive processes to produce beryllium metal from beryl ore (beryllium-aluminum silicate, containing just under 12% beryllium oxide or about 5 per cent beryllium), although both are geared physically

Table 10—Nominal mechanical properties of beryllium

	Vacuum hot pressed	Hot extruded and annealed	Hot Rolled	Hot Forged
Ultimate tensile strength, psi	40,000	90,000	75,000	70,000
Yield strength, 0.2% offset, psi	30,000	45,000	50,000	40,000
E-Modulus, psi	42 X 10^6	42 X 10^6	42 X 10^6	42 X 10^6
Percent elongation	1	10	15	5
Rockwell hardness	B80	B90	B100	B95

Table 11—Properties of beryllium compared to various metals

Metal	Density gm/cc	Melting point C	Specific heat @ 20 C cal/gm/°C	Thermal Conductivity @ 20 C cal/ cm^3/cm/°C/sec	E-Modulus 10^6 psi
Beryllium	1.85	1285	0.5	0.38	42
Magnesium	1.74	650	0.25	0.38	6.5
Aluminum	2.70	660	0.215	0.53	10
Titanium	4.54	1820	0.126	0.41	16.8
Zirconium	6.50	1750	0.066	0.05	14
Iron	7.87	1539	0.11	0.18	28.5
Columbium	8.57	2415	0.065	0.132	19
Nickel	8.90	1455	0.105	0.22	30
Copper	8.96	1083	0.092	0.94	16
Molybdenum	10.20	2625	0.061	0.35	50

and economically for beryl concentrated to a minimum of 10% beryllium oxide.

Hot-pressed beryllium billets

The Beryllium Corporation employs the Kawecki-Capeaux extraction process using thermal reduction of beryllium fluoride to make the end product, beryllium, in the form of "beads" or "pebbles."

However, because these beads may contain over 1% magneisum, further processing is required. The beads are melted in a vacuum furnace—a 3000-cycle, 200-kw induction unit—using graphite as the mold material. After an operating cycle of about 5 hours, the result is a nuclear grade, vacuum-cast beryllium metal ingot, usually 9 in. in diameter by 18 in. long, weighing about 70 to 75 lb.

This cast-metal ingot, however, does not lend itself to fabrication because of coarse grain structure, extreme brittleness, surface defects caused by gas evolution at the mold surface, porosity, internal cracks, and other serious flaws associated with the cast metal. **No satisfactory technique has yet been developed for the production of sound, fabricable beryllium castings of reasonably large diameter.**

Making beryllium that can be machined into end products was solved with the development of a powder-metallurgy process utilizing hot pressing. Vacuum-melted pebbles are cast into ingots and are chipped from end to end on special lathes. The chips thus formed are collected by means of a pneumatic system into 55-gallon drums, then sent to attrition mills where they are ground to a –200 mesh powder.

These attrition mills are especially designed to comminute the chips between beryllium grinding plates in a nitrogen atmosphere. They contain within their systems screening equipment which classifies the product to permit recycling coarse particles.

Powders from the attrition mills are subjected to various tests for cleanliness, purity, particle size, and other specifications, then allocated by number of pounds to each job. Packing density of loose powder is usually a function of size distribution and shape of particles—shapes approaching random-sized spheres show better packing densities. Densities over 55% can be achieved with vibration.

Starting with powder, fully dense beryllium shapes may be produced commercially either by vacuum hot pressing or by press forging. Powders are hot pressed in graphite or steel dies, at temperatures of about 2000 F and pressures of from 500 to 1000 psi. For press forging, the powder is usually loaded into a steel can then heated to about 1900 F in air. Open dies are sometimes employed, although closed dies are in more general use. Shapes weighing as much as 700 to 800 pounds are now being made by hot pressing on a routine, production basis.

Other techniques besides vacuum hot pressing are warm pressing, hot pressing and coining, hydrostatic hot pressing, and pressing and sintering.

Beryllium is now being used in high-volume, high-speed production, and even has been adapted to tape-controlled, fully automatic machining for the fabrication of as many as 5,000 complete all-beryllium gyro housing units.

One beryllium fabricator has installed two of Pratt & Whitney's Potter and Johnston lathes equipped with programming units which provide more than 25% reduction in set-up time and ultimate cost of the product to the customer.

The same fabricator is currently using a Micro-Path magnetic tape machine with Ampex recording and reproducing units, using a Mobius-loop continuous rewinding and playback device for automatic repeat operations. This machine can be readily adapted to operate any machine tool in his shop for the drilling, boring, milling, turning, and other machining of beryllium metal without the need for an operator to check speeds, feeds, and depth of cut.

Besides making possible volume production with a high degree of accuracy, these new machines provide the long-sought goal of *reproducibility* in beryllium fabrication without any sacrifice of the precision tolerances for which the metal itself is so well adapted. It is a me tal to conjure with.

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THE ALLEN-BRADLEY LINE of BULLETIN 700 RELAYS IS COMPLETE!

TYPE B general purpose relay shown with 2 N.O. and 2 N.C. contacts. Made with up to 8 poles in various arrangements.

TYPE BX universal relay shown with 4 poles having both N.O. and N.C. contacts. Additional contacts on the 6 and 8 pole relays are N.O. only.

THESE IMPROVEMENTS ARE *IMPORTANT!*

These improved Bulletin 700 Type B and Type BX relays are establishing new standards for relay life and reliability. New design increases mechanical life by *at least 5 times* . . . a new contact motion insures *at least 10 times* greater electrical reliability. Double break, silver contacts never need maintenance, and the new molded coil is impervious to the most severe atmospheric conditions.

These new A-B relays—with their *extra millions of trouble free operations at no increase in price*—are a bargain in the relay field. Write for complete details, today.

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NEW ENCLOSURES

for the Bulletin 700 relays are styled by Brooks Stevens—internationally famous industrial designer. Note the "family" resemblance of these enclosures.

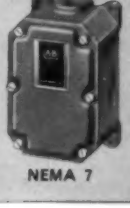
NEMA 1

NEMA Type 1 for general purpose applications with wrap-around cover for ready accessibility. It has a "quality" appearance.

NEMA 4

NEMA Type 4 enclosure for applications that require a watertight and weatherproof seal.

NEMA Type 7 enclosure for NEC Class 1, Group D hazardous gas locations.



NEMA 7

11-60-M

TYPE BR Bulletin 700 convertible contact relay shown with four poles. Made with up to six poles in line.

No other relay offers such simplicity in changing contacts from N.O. to N.C. (or vice versa)—it takes only 60 seconds!

A four pole unit provides any of the contact combinations otherwise available only with five relays of the fixed contact type. You can reduce your relay inventories. In tests, this relay has *proved* it will provide many millions of trouble free operations. Double break, silver contacts never need servicing. Also, each relay can have one or two complete and full rated contacts added to its base—in the field—without increasing space requirements. If you don't know about the Type BR relay, let's get acquainted.

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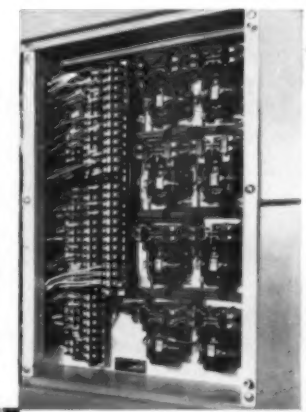
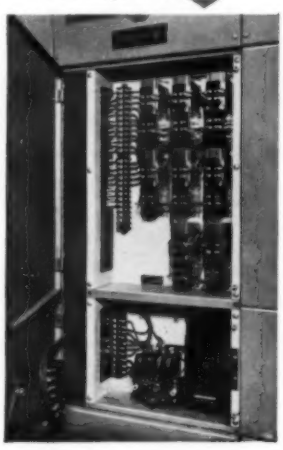
Allen-Bradley Bulletin 798 Multi-Unit Control Center

This shows A-B control center unit with popular A-B Bulletin 709 solenoid starter and circuit breaker.



This shows A-B Bulletin 700 control relays mounted in an A-B control center unit.

A-B control centers can be equipped with a wide variety of components. These Bulletin 849 timers are used on an automatic conveyor line.



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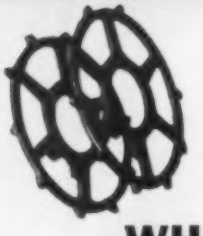

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One-Stroke Rim Holes—I

By David M Bauer, Norristown, Pa

Rim holes are applied to sheet-metal parts for a wide variety of purposes:

- To provide metal for a sufficient number of tapped threads, to hold a fastener securely.
- To act as a tubular rivet to secure thin springs and flat stock when headed with simple riveting tools.
- To grip solid or spring pins.
- To act as stops for levers.
- To act as locators for mating parts. Two blanks of different thickness can be rim-holed together in one stroke. The two parts are easily separated but fit snugly when put together.
- To provide a durable bearing surface for sliding rods or hinge pins. A rim hole will outlast a punched hole many times before showing appreciable wear.

There are many names for rim holes. They have been called flanged holes, extruded holes, burred holes, and holes with hubs or rims.

Various ways have been developed for making rim holes. The tooling and formulas supplied apply to one-operation tooling for rim holes.

Almost any metal can be rim holed, provided its ductility permits extrusion. The inside surface of the rim is burnished to a mirror polish and is held to the exact size of punch without springback to a smaller diameter.

The height of the rim depends on metal thickness, punch diameter, and relationship of the punch diameter to the die bore. Rim height will be approximately 2½ to 2¾ times metal thickness.

Limitations on diameters and stock thicknesses are not easily found without experimentation. Factors such as type of material, its thickness and ductility must be considered.

My tools did not go above 0.160 in. ID for rims. So, I made a punch for rim ID of 5/16 in. and a die with three different sized bores of 11/32, 3/8 and 27/64 in.

A batch of rims was extruded in different metals of varied thicknesses with these results:

For luster C R steel 0.035 in. thick, I was able to extrude a rim without cracks and a rim height 5½ times stock thickness. Rim edge was remarkably smooth for such a long draw. Rims of this type are used for joining tubing to sheet metal for brazing, as in refrigeration, automobile radiators and many other similar products.

Not having any soft 1/16 in. C R steel in stock, I used what was rated half hard. Rims with good proportions resulted, but with some roughness and cracking at the rim's outer edge.

Soft aluminum 1/16-in. thick produced "beautiful" rims, using 40% control. Also used a larger die bore than 40% and they came out just as good but with larger radius at rim's base.

Both the 1/16 in. aluminum and CR steel produced rim height 3 times stock thickness.

However, I suggest using a 5/16 in. rim ID for material up to 1/16 in. thick as the largest size. I feel sure it's possible to go to a larger diameter and thicker material.

Tooling Requirements

Tools are comparatively inexpensive to make, require less accuracy than tools for plain punched holes and last longer before requiring sharpening. The average machine shop, with only the usual run of equipment, can successfully make the punches and dies.

Presses without tight-gibbed rams can be used, from arbor presses to power punch presses. Power required for a 5- to 6-rim hole die can be obtained from a hand press.

Slug Control

The piercing tip of the punch normally pops out the slug and it drops through the die opening. However, some metals stick to the punch tip by adhesion. Lubricants often have a tendency to hold some slugs by suction. If slugs are not removed before the next press stroke, the punch will not be damaged but the edges of the rim will be rough and sometimes cracked. Slug removal can be accomplished by an air blast or flat springs that rub across the punch tip on the upstroke of the press.

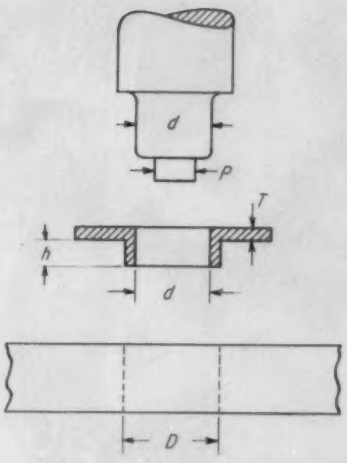

Fig. 1

Pressure pads are not required. The metal surrounding the rim at its base will be flat without wrinkles or crimp marks.

Ejector pins or plates are not used. After the rim has been formed, the punches on the upstroke will withdraw the rims from the die bores and the stripper will shed them from the punches.

Strippers are important. They must be rigid. Stripper holes should be a close fit and locate the punch in the center of the die bore; otherwise the top of the rim will be lopsided and thin walled on one side.

Formulas for Rim Holes

These formulas are based on a rim control percentage that determines rim-wall thickness and

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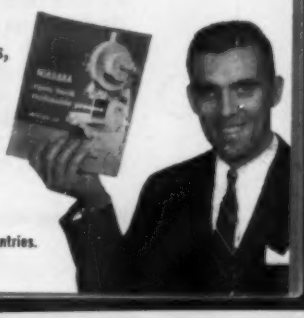

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One-Stroke Rim Holes—II

height. The punch has two diameters: piercing and extruding (Fig. 1)

Let D = OD of rim hole (equal to die bore)
d = ID of rim hole = dia extruding section of punch
P = dia piercing section of punch = $d/2$
T = stock thickness
K = rim control percentage (40% for general run of sheet stock used in production)

To find rim diameter, when rim hole is known:

$$D = d + (2T - K \times 2T)$$
$$= d + 2T\ (1 - K)$$

Example:

Stock thickness T = 0.035; rim control percentage = 40%, and d = 0.145

$$D = 0.145 + 2 \times 0.035\ (1 - 0.40)$$
$$= 0.145 + (0.07 \times 0.6)$$
$$= 0.145 + 0.042$$
$$= 0.187$$

To find rim hole diameter when outside diameter is known:

$$d = D - 2T\ (1 - K)$$

Example: D = 0.187, T = 0.035, and K = 40%

Then d = 0.187 − 0.042 = 0.145

In both cases, the diameter P of the punch's piercing section is taken as 50% of d or 0.145/2 = 0.073.

By using a rim control percentage of 40%, the metal is thinned 20% per side. A rim with a smooth, thinner and slightly higher wall can be achieved by increasing the rim-control percentage to 50 to 60%. The type of stock used, its hardness, surface finish and lubricant will affect results. The 40% figure gives excellent results for the general run of sheet stock.

Experimental Tools

The tool elements for making rim holes in different materials for testing are shown in Fig. 2. A hand punch press is used so that the action, while making the rim, can be observed. The ¼ in. dia. punch is adequate for stock up to ⅛-in. thick without possibility of breakage.

PUNCH—The section *A* is formed with the cutting edge of the tool at right angles to the blank axis. The shoulder created will act as a stop for the press ram, leaving the stock flat back of the rim. There should be a slight radius at the shoulder.

The nose of section *A*, or forming portion, is set approximately at 26° back to produce an angle for later forming a radius. At the junction of sections *A* and *B*, the radius should be formed with a small fine-cut file to remove any slight corners. Section *A* should be polished.

Punches should not be tried experimentally before hardening for they will be scored at the extruding section. However, light scoring can be leveled out with a fine grit stone and oil.

DIE—When only a limited number of experimental rim holes are to be extruded, say about 25, a piece of ¼-in. cold-rolled flat stock can be used.

The die bore is drilled and reamed to size. A slight radius is required at the bore edge. A shop-made abrasive-cloth polishing spindle, used in the drill press, will give an excellent finish to the inside of the hole.

STRIPPER—Most hand presses are furnished with a stripper, but make sure it is tightly secured and rigid to prevent bending when shedding the rim from the punch, or the punch will break off.

LOCATOR—This device fits in the bore, and the punch piercing tip is lowered and located in its center hole. Then the die can be secured to the press bed and the tools will be in alignment.

LENGTH OF PUNCH—The piercing

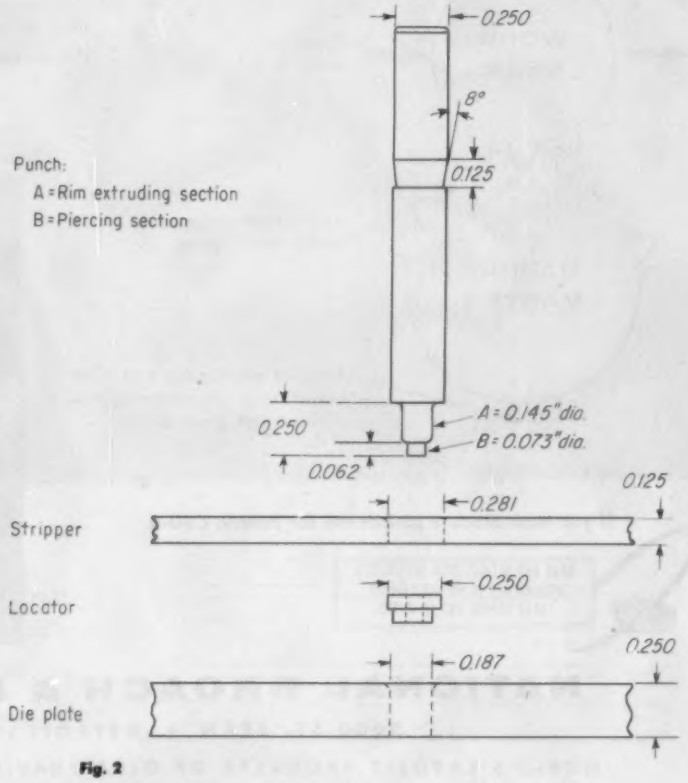

Fig. 2

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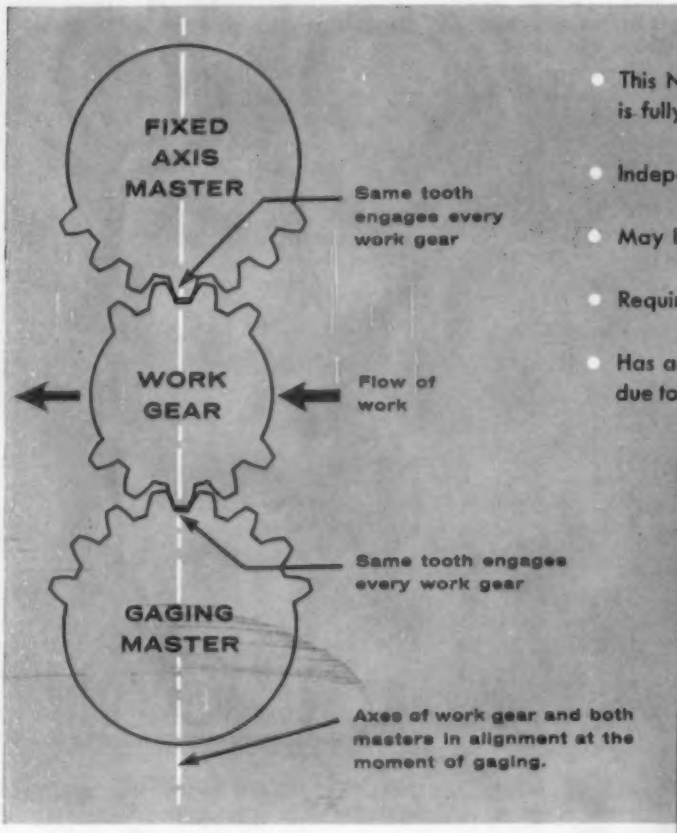
Check pin-size of 1,000 gears per hour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One-Stroke Rim Holes—III

section should be 0.0625 in. long for stock up to 1/16 in. thick. Rim extruding section must have a length not less than four times stock thickness, for the punch must proceed through the material far enough so the rim diameter will be the same to the other edge.

DIE BORE—The die bore is drilled and reamed to size. A reamer that is a few thousands over or under size will not materially affect the finished rim, unless the outside of the rim is to be used and must be an exact diameter. A slight radius is required at the bore edge.

Effects of Material

Various metals can be rim holed but the temper is important. Brass, copper, aluminum and cold-rolled steel have all been worked successfully. However, avoid use of material that has been skin rolled. This mill operation produces a hard surface skin that will cause cracking and torn or weak rims. If multiple rim holes are required in the part, the stresses setup in skin-rolled or tempered stock will induce distortion or bowing.

The effects of material and temper were determined by rim holing various metals with an experimental die. The results using 40% rim control were:

Test No. 1 — Luster-finished cold-rolled steel, 0.035 in. thick. Height of rim hole, about 2 T. Uneven, rough edge on rim.

Test No. 2—2S-½ H aluminum, bright one side, 0.032 in. thick. Results: h less than 2 T; rim hole uneven.

Test No. 3—23S-73 full-hard aluminum, 0.032 in. thick. Rim torn out before it was formed.

Test No. 4—copper, ⅛ to ¼ hard, 0.032 in. thick. Results: h about 2 T. Rough, burred rim.

Test No. 5—CR steel, 0.035 in. Good rim hole that headed smoothly when it was used to attach 0.0115 spring stock.

Test No. 6—Luster-finished CR steel, two thicknesses rim holed in one stroke. Upper piece, shed by stripper, had thin sharp rim hole about one-metal thickness in height. Lower part, lifted from die, had rim hole as produced in Test No. 1. Parts nest firmly.

The following tests were made with 60% rim control, and five punches in a row:

Test No. 7—Luster CR steel. Height h about 3 T. Thin rim wall, sharp opening. Some of the rims were torn or cracked.

Test No. 8—2S-½ H aluminum. Rims did not tear or crack, but the outer edges were sharp and thin.

5-Hole Die

A die for producing 5 rim holes at once is shown in Fig 3. Desired ID of the rim holes is 0.1425 in.; the material is luster-finished CR steel 0.035 in. thick. Here 60% rim control is applied. In this case:

$$D = 0.1425 + 2 \times 0.035\ (1 - 0.60)$$
$$= 0.1705$$
$$P = d/2 = 0.1425/2 = 0.071$$

The die was made by use of progress data sheets, because complete information is supplied to the diemaker. In essence, these sheets call for drilling, redrilling, reaming and tapping the seven pieces of stock used for the punch plate, punch holder, stripper, stock guides, die plate and base.

The seven pieces of stock are sawed to size and two adjoining edges are finished square and the corner stamped *S*. Next, the punch holder is blued with the *S*-side up and the coordinate lines for hole centers are scribed, working from the two squared edges. Punch holder, stripper, die plate and base are clamped together and four spring-pin holes are drilled in the corners. Spring pins are pressed in with an arbor press and two leader pin holes are drilled, likewise five undersize holes at the punch locations. Then the spring pins are removed and the holes finished to their final sizes.

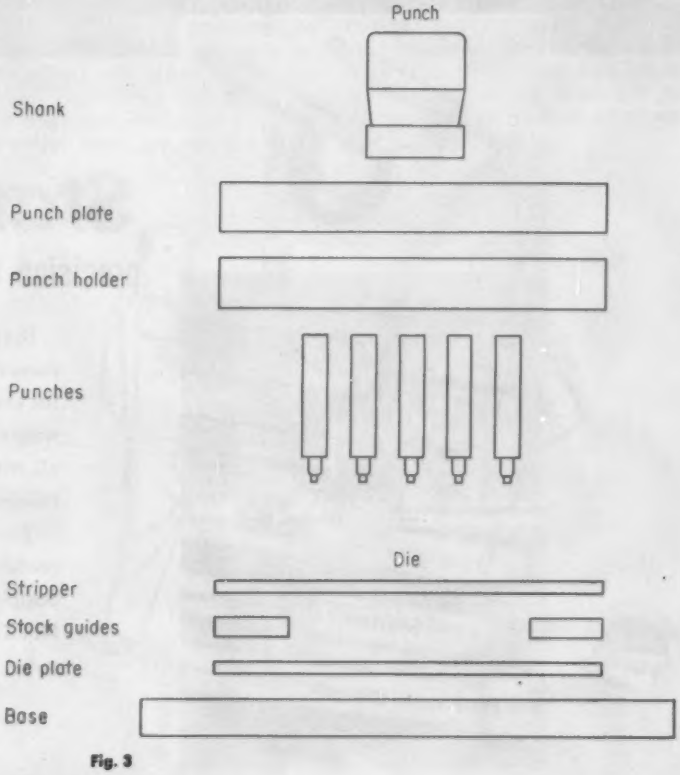
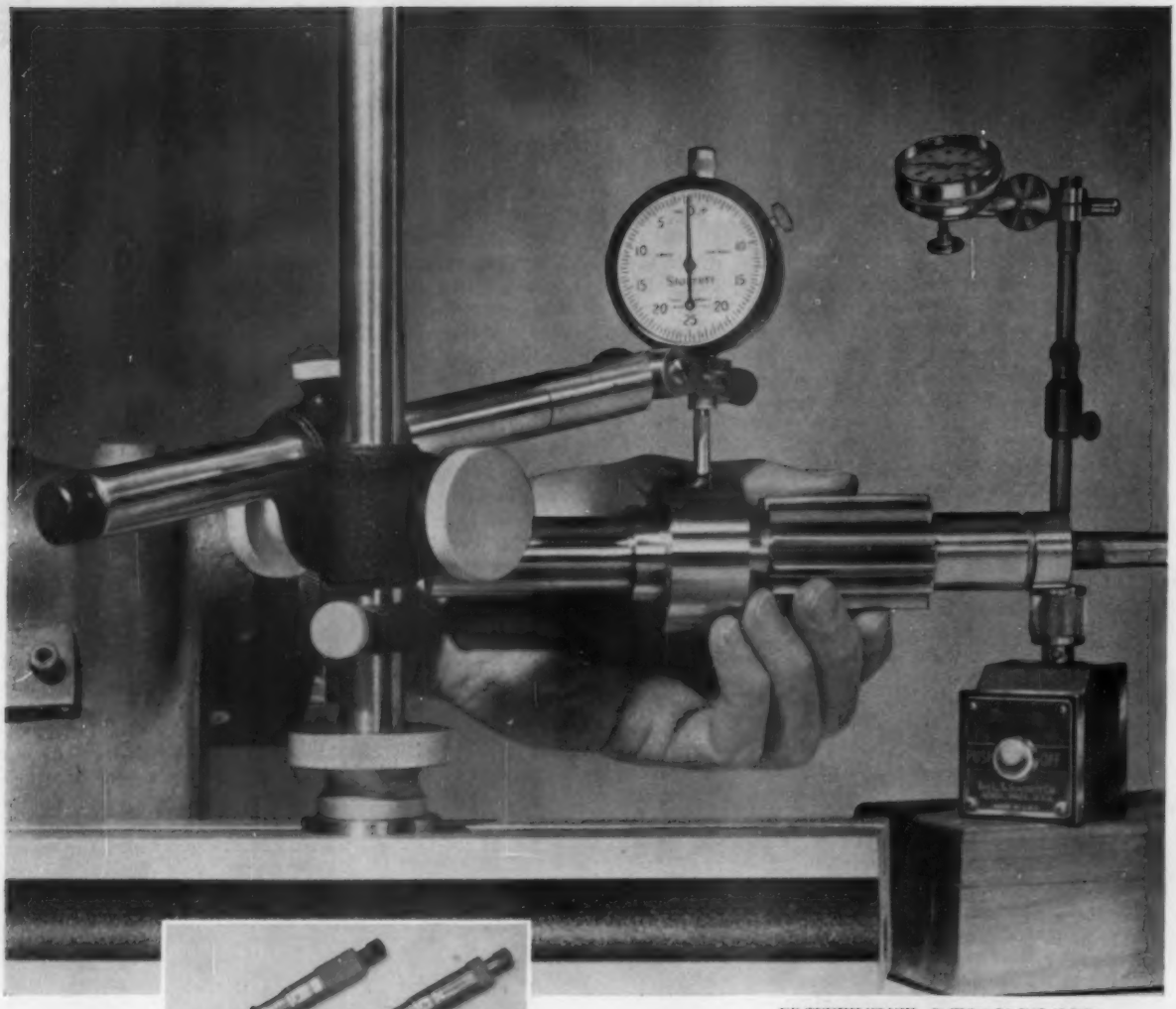


Fig. 3



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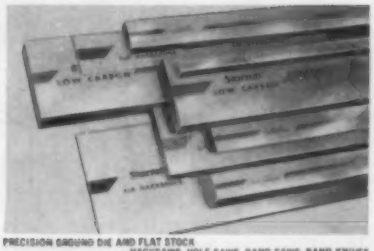

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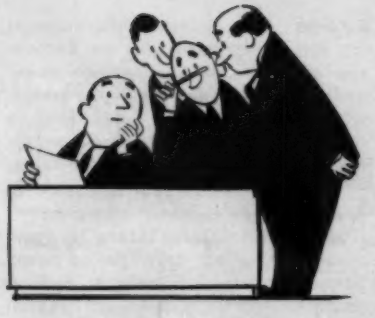


Unsung Heroes

Among the people who help keep the wheels of manufacturing turning, the ones you hear the least about are the thousands who make up the technical committees that develop standards. Most technical societies and trade associations have a number of such committees; some have scores.

On many of these committees, most members are from outside the organization. Each committee is balanced to represent different points of view. Their accomplishments usually funnel up through coordinating committees to the American Standards Association.

All this work is voluntary. Protracted hours of patient (and impatient) negotiation may be needed on points of basic disagreement. Whenever standards are attempted in a new area, the usual complaint is "To standardize this is impossible." But after the agreement has been in effect some years, the more likely comment is "How could we operate without it?"

A tribute, then, to all the men who serve on technical committees — even when we disagree with them.

International Contrast

The above comments about standards are inspired by the session in New York last month of the International Organization for Standardization (ISO). At the same time that the disputes in the United Nations were spilling all over the East Side of Manhattan, the ISO was meeting quietly on the West Side. Delegates from ten countries (US, Britain, France, Hungary, Italy, Poland, Sweden, Switzerland, Czechoslovakia, and from India) were working a few steps closer to agreement on a number of pending questions. The negotiations went calmly, though persistently, under the patient but firm control of the President, General Pierre Salmon.

We might add, after sitting in as a minor delegate of a major member country, that language is a major barrier to agreement. Whether in the ISO or in the UN. To see the delegates and the interpreters wrestling in different languages with the nuances of terminology, and to see contention decline when understanding breaks through, is to wish that we could standardize language as we may one day standardize the movements of controls on machines.

Definition

"Admiration is our polite recognition of another's resemblance to ourselves"—*Ambrose Bierce.*

Bugs and Iron

Some years ago there was a chilling poem by Stephen Vincent Benet, with a last line that read "—and reaching down / he pried from the insect jaws the bright crumb of steel." This nightmare of termites bringing our world tumbling down came to mind when we learned from the Armco Research Laboratory that there are really bugs that eat iron.

Actually, they are bacteria that gobble iron dissolved in water, then excrete insoluble ferrous hydroxide —a source of rust that causes red water from pipes to stain clothes.

One class of "iron eaters" is believed responsible for creating the Mesabi iron ore range.

And the remains of such bacteria found in the core of a newly fallen meteorite were the first evidence that there is life in outer space.

Deep Thought

When the going gets tough, the tough get going.

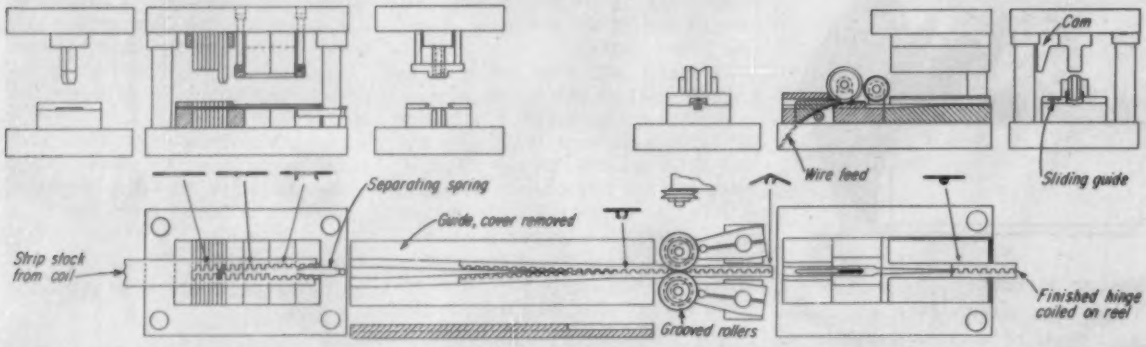
Experiment

The cooperative program at the University of Cincinnati has been enlarged by the establishment of undergraduate fellowships in engineering. Selected students work on a significant research effort sponsored by an industrial concern. The program is carried out partly in the facilities of the sponsors and partly in the laboratories of the University. Students normally work in pairs on related projects during the third term of their junior year, through the first term of their senior year.

We learned about the new program from Hans Ernst, who has been working on its development since he "retired" as director of research at Cincinnati Milling.

Practical Ideas

Tandem Dies Turn Out Hinge by the Mile

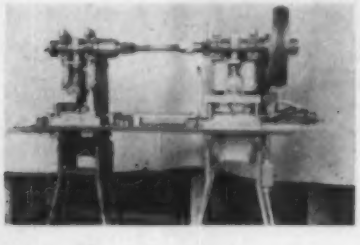


Strip stock is fed from coil into one die where it is punched and formed. It is then transported to a second die for insertion of wire and lockup after which assembled hinge is coiled up at the rate of 200 ipm.

This is a feat performed by two separate dies mounted in two 5-ton presses which are coupled together and powered by one source. A 1 hp motor drives the presses at 200 rpm through reducing pulleys. The linkage between the two consists of a shaft with a universal joint at each end joining the crank shafts of the presses in perfect synchronization.

Taken from the coil, the stock is fed into the first die by a small push feed activated by a cam on the punch holder. Here, in the first of three stations, two rows of opposite and offset teeth are cut out of the center of the strip, simultaneously dividing it in the required two halves of the hinge. In the next station, the extreme ends of the teeth are bent downward, the first step in their roll forming. The third station produces a second small radius, this one closer to the root of the teeth.

From here, the two hinge halves are fed through a guide located between the presses on a steel plate which serves as base for the entire setup. The guide's channel, being tapered, gradually forces the two halves together meshing the teeth. A pair of V-grooved rollers, adjustable as to spacing between them, buckle the sections to an inverted angle. This is to create a greater space between the two rows of joined and partially rolled teeth before the strips enter the second die.



Here they are received by a channel, maintaining the same angle with the aid of a top roller, and a wire guide which directs wire from a coil under the base plate into the space between the teeth. Thus inserted, the wire is locked in place by a flat roller that begins the flattening-out and final curling process.

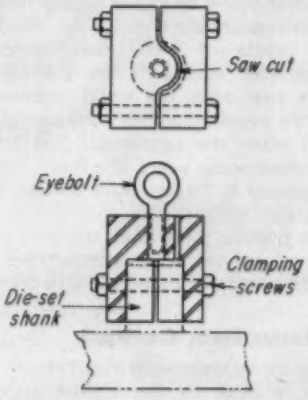
This process is carried out in stages as the now assembled hinge progresses over a tapered groove in the assembly die. Each stroke of the press brings a flat punch down on the hinge forcing the teeth to curl around the wire as they are pressed into the groove. A cam, mounted in back of the punch, slightly moves the back guide rail inward for a snug curling job.

The cutting die is an assembly of 16 blades—half of them longer than the rest—and two end pieces. Each group is ground as a unit to insure accuracy and, to provide the necessary clearance between the teeth, the long blades are made a few thousandths thinner than the shorter ones. All cutting edges have clearance angles. The blades and end pieces are joined into a rigid assembly by dowels and transversal screws (none are shown for clarity). This section is covered with a simple stripper plate. The next two stations are the pre-rolling dies which are followed by a separating spring.

Construction of the cutting punch is similar to that of the die, except that blades of identical widths are joined with end pieces to form the assembly. The last two plates, being longer and tapered at the point, make up a pilot which engages the area shaded in the die drawing.

Finally, some experimentation will be necessary to properly position the two grooved rollers that buckle and guide the hinge strips into the second die. These rollers are hardened and mounted on ball bearings for minimum friction.

P Dryere, Col Campestre, Mexico



Clamp Simplifies Die Handling

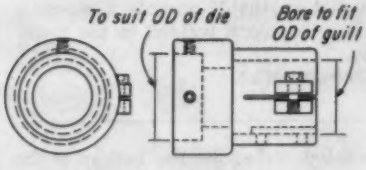
Here is a piece of equipment that will help you do a professional job of die handling with little or no rigging knowledge. It also makes die manipulation safer where, in many cases, chains or slings would be at a disadvantage or risky to use.

Applying this clamp is faster and easier than any other method of rigging. It is merely dropped over the

punch-holder shank and, with a wrench on the screw head and another on the nut, the screws are tightened. The hoist hook is then slipped into the eyebolt and the die set can be pulled apart, or handled as a unit if C-clamped or or strapped together.

The clamp body is made from a piece of rectangular steel which is bored to slip over the dieset shank. A hole is then drilled and tapped though the remainder of the block to take a sturdy eyebolt. After two holes have been drilled for the clamping screws, the block is bandsawed into two pieces in the manner shown in the sketch.

M W Loftus, Chicago, Ill



Threading-Die Holder Mounts on Tailstock

This die holder makes easy work of putting a thread, long or short as desired, on rod stock. Gripped in the lathe chuck, rotating at a low rpm, the work is threaded by feeding the die onto it. The fact that the holder is mounted on the OD of the tailstock quill—leaving the bore clear—makes cutting exceptionally long threads possible.

The holder is made from a piece of steel bar, bored to a slip fit over the quill. A pair of lugs, for clamping the holder in place, are formed by a piece of steel welded to the side and later split with a slitting saw. The slit is allowed to continue through the wall of the holder for flexibility and a hole is drilled through the lugs and tapped for a suitable screw. To insure that the holder won't slip on the quill, a key to engage the quill keyway is inserted in the bore in the manner shown.

The die seat in the front end is bored as concentric with the clamping section as possible. However, for the utmost in accuracy, it is only rough bored and then finish bored while mounted on the quill with a tool gripped in the chuck. The through bore is then also finished. Two setscrews are provided to hold the die.

After each use, be sure to clean out all traces of chips from the quill bore.

Arthur H Powers, Austell, Georgia

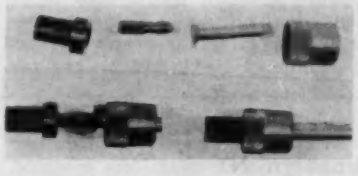
Vibrations Reveals Flaws

Testing a piece of steel shafting for cracks without expensive flaw-finding equipment is not difficult. You simply wash the piece in clean solvent, wipe it dry with a clean cloth, and suspend it vertically with a piece of wire.

After tapping the shaft lightly along its entire length with a hammer, inspect it for signs or cracks. The vibration set up by the tapping will have expelled solvent and oil to pin point the exact location of the crack.

To be doubly sure, repeat the test once or twice more as the crack itself may not be visible to the naked eye.

E Mayover, Bradenton, Fla



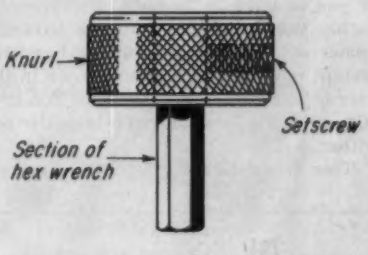
Screw Jig Speeds Alterations

In making changes on machine screws—whether it involves extending the thread or shortening the length—the idea is to grip them without causing damage while performing the operation. This is now being done with a variety of devices, but most are troublesome to use; some employing split bushings and others requiring complete removal from machine.

An easier way is by the simple jig shown. Its shank, having a hex socket, can be fitted with driver bits of every type and description. And then too, one jig can take a number of different-sizes as the screw head's beveled underside seats and aligns the screw.

Top portion of the photo shows an exploded view of the jig's three parts and a screw to be altered. The shank, at left, can be made from the head and section of a stripper bolt. The driver bit (next to the shank) is fashioned to fit the screw head in question. It can either be made from a piece of hex wrench or machined in full from tool steel. At right is the chucking nut which is threaded to fit the shank and bored with a bevel to match the screw. A knurled collar on the OD insures a better grip.

T/sgt Norman P Trahan, Holyoke, Mass



Spin Wrench Speeds Die Work

Some maintenance work will, from time to time, be necessary on dies during a long run. When such work can be done with the die still in the press, a lot of time is saved but, by the same token, the workspace problem increases. This is easy to see if you imagine a press with a 2 or 2½-in. stroke, and a half dozen or more screws to be removed before a stripper plate can be pulled.

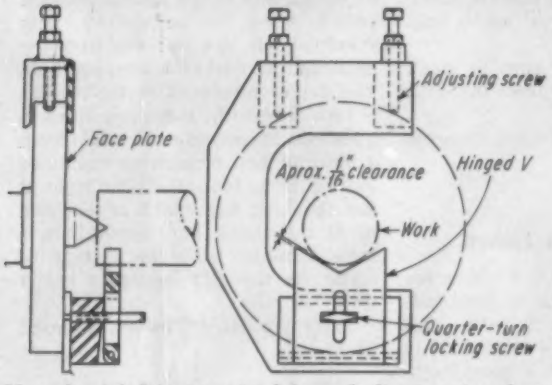
The closeness of stops, guide posts, and air-blast mounting makes it often impossible to swing a standard hex wrench. And the long wrench shank is usually too long to be used in the space between the die and the punch.

To overcome this difficulty I have made up sets of spin wrenches in various lengths. They consist of sections of hex-wrench shanks fitted with knurled knobs that usually are two or three times the diameter of the socket-head screw in which the wrench fits. A shank piece is either pressed into the central hole in the knob or it can be retained with a setscrew as shown in the sketch. Obviously, these wrenches are used only after the screws have been loosened or, in assembly, before they are tightened.

Bernard Mabey, Haethorne, Calif

Practical Ideas

Work-Loading Support Provides That Extra Hand



If you've tried to mount a heavy shaft on centers in a lathe, you know that almost invariably you'd do it easier with an assistant at the headstock. Such an assistant is the work support shown in the sketch. What's more, you never have to wait for it to come to your aid, and the boss doesn't have to pay it any wages either.

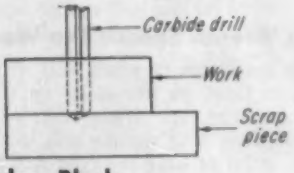
This is a design we settled on as being the cheapest to make and the easiest to use after trying several others. Being of welded construction, the cost of putting it together is small. With the frame band sawed or burned to shape, the only machine work, other than drilling the holes, is cutting the slot for the hinged-V plate.

Essentially, the support is a C-shaped frame on which a V and two adjusting screws are mounted. The V is hinged to permit easy removal of the frame after the work has been set up, and the screws adjust the height of the V to compensate for various work diameters.

Two pieces of angle, with bosses for the adjusting screws welded to them, are welded to the back top edge of the frame. The top portions of the angles are shortened so the vertical leg slips easily behind the face plate. Jam nuts lock the adjusting screws once they have been set to allow about 1/16-in. clearance between the V and the work on center.

The block on which the V hinges is machined to hold the V upright when hinge pin is entered through its bottom edge. A slot in the V accepts a quarter-turn screw tapped into the block welded to the lower portion of the frame.

Frank Murray, Detroit, Mich



Backup Block Saves Drills

When a carbide drill is used to drill hardened steel there's a great danger of it fracturing as its point breaks through the work. Though the recommended use is to hand feed the drill, making control difficult to maintain at break through, the problem would probably be just as great with automatic feed because of the slack in the spindle.

This problem can, however, be eliminated very easily. Just place the part to be drilled on a piece of scrap steel. The backup block must, of course, be parallel and have a smooth top surface for a good contact with the work. Care should also be taken that no indentations on the backup block (from previously drilled holes) are in line with the drill.

So backed up, the work can be drilled to completion without reducing the pressure on the drill as it passes through.

John Gelder, toolmaker, Mercury Aircraft Inc, Hammondsport, NY

Phillips Driver Improved

Although the gripping power of the Phillips screwdriver is said to be greater than the common flat-blade type, it must, nevertheless, be fully engaged with the screw head to be completely effective. This is sometimes impossible as many drivers (particularly No 1 and 2) are too pointed and strike the bottom of the screw-head socket.

But, the remedy is simple. Simply file or grind about 1/32 in. off the tip to produce a flat that will not bottom but allow each flute full contact. The result will be a better grip, no slippage to mar components, and no stripped screw-head sockets.

Harry J Miller, Sarasota, Fla

J H Sperman Brooklyn, NY Won $25 for his idea:

Make Your Own Air-Gage Plugs in the July 25, 1960 issue

AN EXTRA $25 will be paid for the best Practical Idea in each issue of *American Machinist/Metalworking Manufacturing*. Selection of the winning idea is made by a group of our readers.

PAYMENT—In addition to regular rate for item published—will be made as soon as tabulations are completed. The winner or winners—in case of a tie when duplicate prizes will be awarded—will also be announced in these pages.

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REQUIREMENTS—All items appearing in the Practical Ideas pages are eligible. They must be submitted by the originator on an exclusive basis. Do not worry about your shortcomings as an author, draftsman, or photographer—every item will be edited in accordance with *American Machinist/Metalworking Manufacturing* standards. Readers will judge only the finished product—in terms of its usefulness to them.

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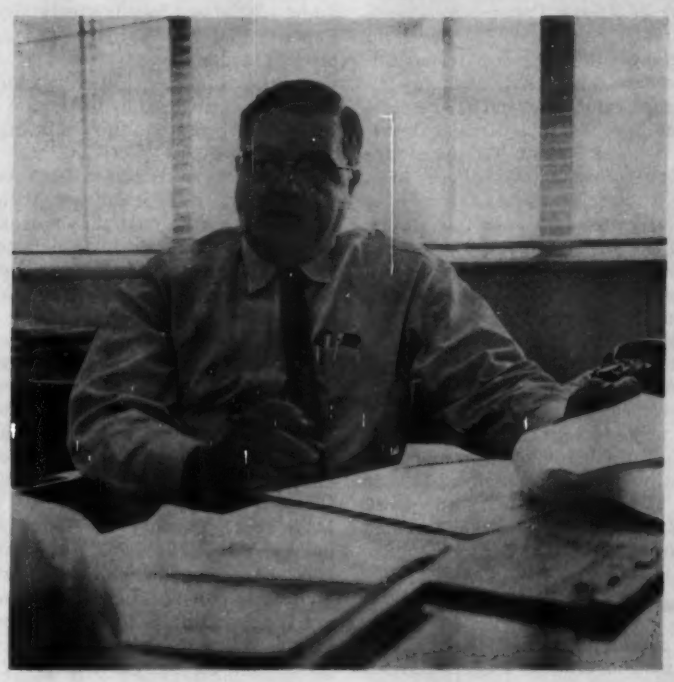
HOW TO ENTER—Send all entries to: "Practical Ideas Editor" *American Machinist/Metalworking Manufacturing*, 330 West 42nd Street, New York 36, NY.

George Papen

is a man who likes the challenge of radically new engineering concepts. His willingness to tackle anything from explosive forming to undersea warfare is one reason why Lockheed gives him carte blanche as a production engineer . . .



Pathfinder

"Let George do it" is a byword at Lockheed Aircraft Co, where they're in the habit of tossing really blue-sky manufacturing engineering jobs into the lap of Staff Division Engineer George Papen. A few of them: establishing airframe requirements, testing the practicality of ultra-high-speed machining, and investigating the possibilities of explosive forming.

George is a sort of Man Who Came to Dinner at Lockheed. Twenty-five years ago, armed with a diploma from Parkes Air College, he turned up at Lockheed for a summer job. College grads being somewhat less than the proverbial dime a dozen during the depression, he spent the next three months deburring aircraft sheet metal parts at 42¢ an hour.

25-year "temporary" job

He really wanted to get with an airline, but by summer's end no job had materialized, so he stayed on—just temporarily, mind you — until the airlines would have an opening.

Today, a quarter of a century later, he heads up Lockheed's Production Design, Methods and Standards, Materials and Processes, and several other engineering functions.

By the late 30s, Papen had been moved up to tool planner, a job that was still a novelty in the aircraft business and consisted mainly of going down into the shop several times a week for an all-out battle. "A tool planner," he says, "soon learned production techniques if he intended to survive in the aircraft business."

Survive George did, learning manufacturing so well his production engineering accomplishments have become almost legendary in an industry noted for its creativity.

Regearing for war output

Papen's first really crucial assignment came in 1939, when Great Britain ordered 200 Hudson bombers from Lockheed, the largest order ever awarded to an aircraft company. Lockheed at that time was still essentially a small company, geared to production of a few planes at a time, and the Hudson contract forced it to cut off all vestiges of small-company production techniques and to acquire mass production skills and capabilities.

Papen became the human catalyst for the job, responsible for balancing design requirements with manufacturing capabilities. He still shudders when he thinks of his battles with the shop's old timers. "They resisted every new production technique."

Ten years later, someone had an idea—why not build presses so big they could stamp out an entire wing or fuselage section in a single strike? The Air Force appointed George Papen member of a committee to investigate its possibilities.

Heavy press program

"Can do," they reported, and thus was born the Air Force Heavy Press Program. Up to that time, little was known of heavy forging and extrusion techniques. Papen and his associates at Lockheed worked intimately with press manufacturers to establish equipment specs and performance guidelines. Out of this research, too, came simpler aircraft

designs, which could be turned out by the big presses, and such new products as thin-webbed, no-draft forgings, and wide-profile extrusions.

Four years ago Papen was among the first to urge the Air Force to undertake ultra-high-speed machining research. At that time, he began experiments inspired by the plastic wave propagation theories developed by G I Taylor and Theodore von Karmen—firing workpieces from a .30-caliber rifle to test for possible application to high-speed machining.

The success of this and similar experiments caused the Air Materiel Command's Manufacturing Methods Branch to finance studies of ultra-high-speed machining of aircraft and missile materials.

Tests made at Lockheed, with explosives as the power source, have since achieved cutting speeds of 15,000 to 250,000 sfpm, with a few tests recording speeds as high as 360,000 sfpm. In the latter tests, the work was projected by the rocket test sled at Edwards AFB in California.

Impact forming pioneer

As an outgrowth of their plastic deformation studies, Papen and his group became intrigued with the possibilities of high-energy impact forming, winning for Lockheed the first Air Force development contract for the explosive forming of metals.

Under this contract, Lockheed has chosen to develop a broad base of knowledge of this field, rather than concentrate on acquiring skills in a few specialized forming techniques. Papen feels this approach will pay off in the long run. Within a few years, he thinks, explosive forming will be an invaluable technique in forming new, exotic alloys for edge-of-space craft.

In his 25-year tenure at Lockheed, Papen has acquired such broad knowledge of the company's overall capabilities that Lockheed occasionally calls upon him to ramrod projects aimed at diversifying the firm's business base.

One such project, and a radical one for an aircraft company, is a monorail designed to provide urban areas with high-speed mass transportation. Lockheed, recently awarded a contract to build a prototype mile-long monorail connecting downtown Seattle with that city's forthcoming (in May, 1961) Century 21 Exposition, handed the job to Papen, naturally.

At the moment, he's doing still another job for Lockheed—coordinating the company's effort to secure a major contract for the Navy's proposed Anti-Submarine Warfare Test Center—a deep sea test range.

Incidentally, busy George Papen, like most Southern Californians, likes to relax around a swimming pool, occasionally whipping up a barbecue for his wife and ten-year-old daughter. He likes to unwind after a hard day's work, too, by playing on his new electric organ. He likes to vocalize along with his music. "The neighbors are divided on the breadth of my talent, but they all agree that I'm loud and clear."

In between such spots of relaxation and his challenging job at Lockheed, Papen finds time to stay active in several professional organizations: the Institute of Aeronautical Sciences (he's an Associate Fellow), ASTE, SAE, National Management Association, and American Ordnance Association.

Challenging years ahead

George Papen, a man who thrives on challenge, looks forward to his next 25 years, which he sees as a time of great change for the aircraft and missile industry.

"Defense output will consist of smaller quantities of more-complicated weapons, in contrast to the high-production techniques of the last 20 years. For this reason, aircraft companies must place far greater emphasis on manufacturing research if they want to stay in business. They must constantly research new materials, becoming familiar with their advantages and limitations, long before they freeze them into final design configuration."

A O Smith Corp has appointed **W A Joubert** western district manager of its Electric Motor Division. Mr Joubert will continue work in the Newark, Calif, headquarters where he has been divisional sales engineer.

Ford Motor Co has named **Julius J Harwood** manager of the metallurgy department of its Scientific Laboratory. He was formerly head of the metallurgy branch of the Office of Naval Research.

Minneapolis - Honeywell Regulator Co has appointed **John K Lincoln** sales manager. Former eastern division sales manager, he succeeds **Frank Wilsey,** recently named vice president, sales. **Richard F Johnson** has been named central area sales manager to replace **Kenneth J Cumming** who has been promoted to sales manager of the Marion Instrument Division in Manchester, NH.

Link-Belt Co has appointed general managers for three of its plants. **T Webster Matchett,** former manager of the Caldwell plant in Chicago, has been named manager of the Pershing Road plant. He is succeeded at the Caldwell facility by **George Ramsden** who has headed the North Central Division in Minneapolis. **Gerald A Stone,** district manager of the Dallas office, takes over Mr Ramsden's former post.

Aluminum Co of America, Pittsburgh, has elected **Lawrence Litchfield Jr** president. Formerly executive vice president, he succeeds **Frank L Magee** who will continue as the company's chief executive officer in addition to serving as board chairman. **I W Wilson,** chairman of the board, has been named chairman of the company's newly formed finance committee.

Roto-Finish Co, Kalamazoo, Mich, has announced that **John R Strom,** chemist and process engineer for Roto-Finish, has been appointed to the newly created post of technical director of **Ransohoff Co,** Hamilton, Ohio. Both companies are under the same management. For the past year Mr Strom has been in charge of the development of finishing compounds for the two firms.

Farrel-Birmingham Co has appointed **R John Hess** manager of metalworking equipment at the Watson-Stillman Press Division.

Brewer - Titchener Corp, Binghamton, NY, has appointed **Roscoe C Roe** manager of the Crandal-Stone Division, producer of stampings, subassemblies, and end product assemblies. Mr Roe, formerly manager of BTC's Refrigeration Division, succeeds **Walter D Sweetland** who has retired.

Consolidated Electrodynamics Corp, Pasadena, Calif, subsidiary of Bell & Howell, has elected **Jack H Zillman** vice president, data processing divisions. He will be responsible for operations of the Datalab, DataTape, Transducer, and Electro Mechanical Instruments division. Mr Zillman has been vice president and general manager of the Pacific Division of Daystrom Inc for the past three years.

Ford Motor Co's Tractor and Implement Division has named **H F Froehlich** works manager of the Royal Oak (Mich) Equipment Plant. Mr Froehlich was formerly vice president, manufacturing, for Sherman Products Inc before that company's acquisition by Ford in July

Buffalo Forge Co has appointed **Curtis H Locke** sales manager, Machine Tool Division. Mr Locke, who has been a sales-engineering representative with the company since 1947, replaces **James Mossell** who is retiring after 48 years of service with the firm

C I Hayes Inc, Cranston, RI, manufacturer of electric heat treating furnaces, has appointed **Stewart B Ashton** chief engineer. Prior to joining the company, Mr Ashton was chief development engineer for the ESI Bridgeport Laboratories, a division of Eversharp

Square D Co, Park Ridge, Ill, has named **Ray W Thompson** general sales manager, marketing division. He is succeeded as midwestern region manager by **Kurt Morris,** formerly merchandise sales manager in charge of regional warehouses.

Borg-Warner Corp has appointed **Edward P La Kaff** chief engineer of its Emcor Ingersoll Products Division, Elgin, Ill. Mr La Kaff moves up from the post of design engineer for the Roy C Ingersoll Research Center of Borg-Warner at Des Plaines.

Timken Roller Bearing Co, Canton, Ohio, has elected **R L Frederick** a vice president in charge of International Divisions. He was previously executive director of the divisions.

Studebaker-Packard Corp, South Bend, Ind, has appointed **Roy B Bender** vice president of the Automotive Division. He will retain his present position as Parts and Service Division manager.

Allis-Chalmers Manufacturing Co, Milwaukee, has appointed **Walter F Strehlow** senior consulting engineer for the Tractor Group. **Robert S Reaves** succeeds Mr Strehlow as chief engineer of the Farm Equipment Division's tractor works at West Allis. He was previously assistant to the director of engineering.

Ace Abrasive Laboratories, Mineola, LI, NY, manufacturer of diamond wheels and compounds, has named **James P Kennedy** general sales manager.

Hooker Chemical Corp, Niagara Falls, has elected **F Leonard Bryant** executive vice president. Mr Bryant has been a vice president of the firm since 1957.

Industrial Finishes Co, Philadelphia, has named **L Robert Meisenhelter** a vice president. He will be primarily concerned with sales activities. Mr Meisenhelter has been associated With Du Pont Co for the past 23 years specializing in sales of industrial finishes.

Instrument Society of America has elected **Dr Ralph H Tripp** president for 1960-61. Dr Tripp, who has served as president-elect secretary for the past year, is assistant director, Flight Test Division, Grumman Aircraft Engineering Corp, Bethpage, LI, NY.

Stewart-Warner Corp, Chicago, has elected **Donald A Potter** a vice president of the firm. Associated with the organization since 1947, Mr Potter became head of the Electronics Division in 1959 and prior to that was an executive of S-W's South Wind Division at Indianapolis

Elion Instruments Inc, Bristol, Pa, has named **Richard A Denton** vice president of the High Vacuum Division. He was formerly associated with New York Air Brake Co as general manager of its Vacuum Equipment Division

Air Reduction Sales Co, New York, has appointed **Roger W Tuthill** manager of engineering for its Special Products Department which makes customized welding systems. Mr Tuthill was previously assistant manager of the equipment engineering and development department

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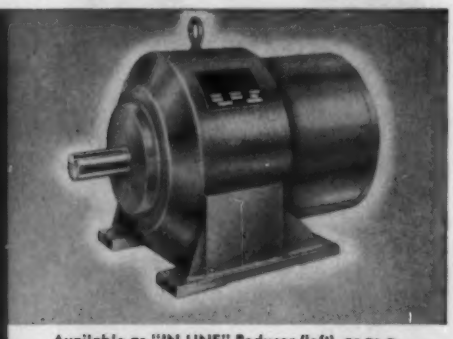
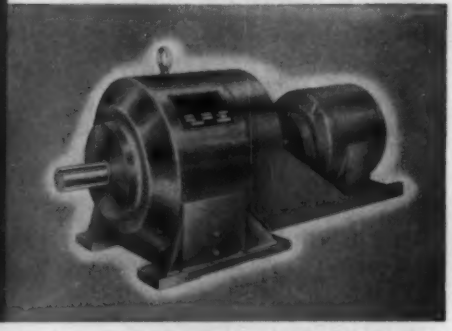


Available as "IN-LINE" Reducer (left), or as a GearMotoR with flange mounted motor (above) or foot mounted motor (below).



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Harder materials, plus reduced load factors means the reducer can transmit more power, operate at higher speeds.

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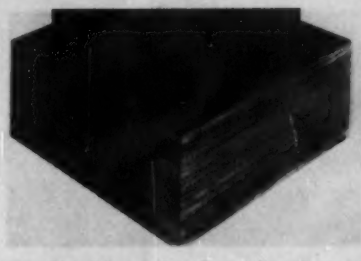
Laminated Woods, With Densities up to 1.4, Work Well in Steel Rule Die Applications



Laminated Lignostone, now being imported from Holland, is supposedly the best available material for steel rule die- and form-blocks. Made from 0.040 or 0.078-in. thick layers of beech, and bound with a 15 to 26 percent phenolformaldehyde resin, this material comes in ¾-in. thick sheets that have specific gravities from 0.9 to 1.38.

This material has even hardness and great impact-, bending-, and tensile-strength. It is lighter than most metals, easy to machine (with HSS or carbide cutting tools) to close tolerances, oil resistant, and also has a low moisture absorption point.

Because it has a shiny, light colored outer finish, it is especially good for lay-out work. Its manufacturer recommends it for any steel rule die application involving accurate blanking, piercing, trimming, or forming applications.

The laminated and cross-bonded material is available in standard sheet sizes from 6 x 9 in. to 36 x 48 in. or 12 x 72 in. Special thicknesses (not ¾ in.) are furnished up to 6 in.

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MORE DATA? Circle 104, inside back cover

Semi-Bright Nickel Can Now Be Continuously Carbon Treated

Permalume—a new sulfur-free, thoroughly tested, semi-bright nickel—can be continuously purified by carbon treatment without loss of addition agents. This means, according to the manufacturer, a great cost and time savings to users, because older type leveling baths must be periodically batch treated with carbon, necessitating extended work stoppages and additional agent losses.

The Permalume deposit is highly receptive to subsequent deposits. The use of a sulfur-free undercoating with a full-bright top coating produces a duplex deposit with the highest corrosion protective properties obtainable.

Not only is Permalume sulfur-free, but also it has great corrosion resistance, a high order of ductility, and leveling and scratch hiding properties. Also, its stress is low on the tensile side.

Hanson-Van Winkle-Munning Co, Church St, Matawan, NJ

MORE DATA? Circle 105, inside back cover

Seymour Nickel Plating Method Eliminates Intermediate Step

Hi-Thro—an improved method of high-level nickel plating—gives base nickel layers with an inherent receptability to an outer bright nickel coating. This process eliminates the necessity for a special step.

Conventional procedures call for an initial treatment of the metals with a special activating treatment, prior to the application of bright nickel surface layers. HiThro eliminates this step.

Compared with base nickel coatings produced with other procedures, according to the company, these nickel coatings have substantially higher leveling characteristics and are inherently activated during the deposition process to provide high susceptibility for the subsequent application of bright nickel platings.

Seymour Mfg Co, Seymour, Conn

MORE DATA? Circle 106, inside back cover

New All-Metal Seal Withstands Extreme Temperature, Pressure

Bar X, an all-metal seal, withstands temperatures from –450 to 1200 F, and peak pressures of 40,000 psi. Called by its manufacturer a major breakthrough in seal design, the seal can be used for the most demanding seal applications in the most critical environments.

In cross section the seal actually resembles an "X", and supposedly is ideally suited to provide elastic deflections and high sealing forces. In an actual application, the seal had zero leakage from room temperature to 1000 F with nitrogen at 1000 psi.

E B Wiggins Oil Tool Co, Inc, 3424 E Olympic Blvd, Los Angeles 23, Calif

MORE DATA? Circle 107, inside back cover

Magic Steel, in Plastic Form, Repairs Almost All Metals

This steel in plastic form, called Magic Steel, is recommended by its manufacturer for soldering, sealing, repairing, and filling all metals. In addition, it sticks fast to wood, glass, porcelain, concrete, stone, and other construction materials.

Applied without heat or tools, Magic Steel dries metal-hard in 2 to 3 hr. Then, it can be filed, sanded, drilled, or painted; it is unaffected by water, oil, gasoline, and most chemicals. It won't rust or corrode.

As well as being offered in half-pint, quart, and gallon cans, the compound is also available in a 6½ oz tube with special applicator cap.

Magic Iron Cement Co, Inc, 14215 Caine Ave, Cleveland 28, Ohio

MORE DATA? Circle 108, inside back cover

New Kendex* Dial-A-Breaker* permits close ganging of tools. All adjustments, chipbreaker and insert, can be made from the top of the holder.

The machine tool you buy is no better than its cutting tool

You may have looked at many ingenious machines and wizard-like controls at the Chicago Show. Perhaps you bought one . . . or are planning to . . . in the hope of increasing production, improving products or reducing costs. *But the final return on your machine investment depends upon the tooling.*

It doesn't pay to spend thousands of dollars on machines . . . then try to save a few pennies when tooling up

Whether the machine is one of the latest, high speed, numerically controlled types or an older model . . . you will make more, products and dollars, by equipping it with the BEST tools you can buy.

The best tooling is especially important for machines operated by numerical controls. Inserts must be of uniform quality for predictable service life. Toolholders must be designed for quick indexing of inserts and fast adjustment of chipbreakers . . . to minimize set-up time, improve accuracy and reduce scrap.

The new Kendex Dial-A-Breaker, shown above, is especially well suited for automated operations. Its attached, quick-adjusting chipbreaker shortens set-up time, speeds insert indexing, assures optimum chip control and eliminates the need for a different chipbreaker for every job. *Only two sizes of chipbreakers are needed to service 76 styles and sizes of holders.* The Dial-A-Breaker eliminates chipbreaker grinding, simplifies stocking.

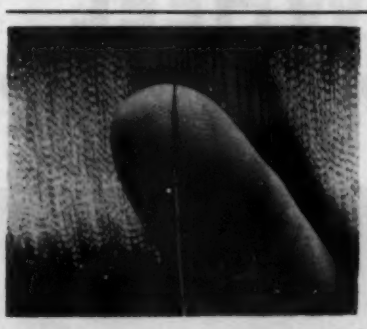
From the versatile Kendex line, you can get the tool best for every job. There are 110 standard styles and over 400 toolholders to select from. Or, we can help you develop special heads with Kendex throwaway inserts that may permit several operations to be performed in one pass.

For maximum production, make certain you have the most productive tooling on your machines. Call your Kennametal Representative. His only job is applying Kennametal* hard carbides to tooling and specialized uses. KENNAMETAL INC., Latrobe, Pennsylvania.

*Trademark

33546

INDUSTRY AND
KENNAMETAL
...Partners in Progress



National-Standard Offers Wire With Electroplated Brass Finish

A stainless steel wire, which has been electroplated with brass, combines the characteristically good adhesion of brass to rubber with the corrosion resistance of stainless. This process, which is said to be a first, achieves an adhesion between the brass plating and the stainless surface that exceeds the adhesion between the brass and rubber.

Initial applications are expected in high-pressure hose (where braided wire construction provided only mechanical adhesion in the past) and in timing belts (where wire reinforcement was previously impractical due to the poor adhesion qualities of stainless steel wire needed for corrosion protection).

The electro-plated stainless wire is available on all common types of stainless, ranging from 0.007 to 0.103 in. diameter. The wire, packed in dessicated drums, is available in coils and on spools according to general industry practice. This new wire is priced approximately ten percent above ordinary stainless, depending on wire size.

National-Standard Co, Niles, Mich

MORE DATA? Circle 109, inside back cover

US Steel's New Thinner Tin Plate Is Now Commercially Available

Although it was announced in the pilot stage earlier this year, Ferrolite, the new thinner tin plate, is now commercially available in weights of 45—60 lb per base box. The price of the new product, about half the thickness of tin plate now used in can making, ranges from $6.10 to 6.65 per base box at mills.

United States Steel Corp, 71 Broadway, New York 6, NY

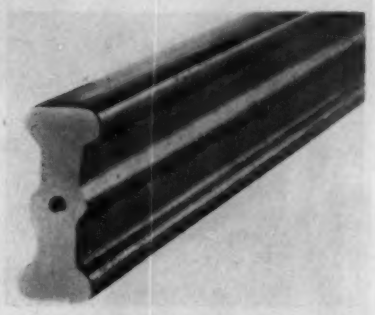
MORE DATA? Circle 115, inside back cover

Additive Prevents Red Smut

Ebonol Additive "S", for steel blackening baths, prevents the formation of red smut on blackened work. This new additive ties up dissolved iron and copper so that they cannot deposit on the blackened steel as red iron hydroxide or red copper smut. In addition, it produces a deeper black color and reduces blackening time.

Enthone, Inc, 442 Elm St, New Haven 8, Conn

MORE DATA? Circle 110, inside back cover



T-Bone Nickel Anode Design Has 40% More Area per lb Than Ovals

A newly designed nickel anode, called T-Bone, gives an approximate 40% increase in surface area with no increase in weight. Because it generates a dark brownish film, it eliminates bagging; also, sludging is reduced.

This anode erodes into a flat spade-like section which maintains more anode area than conventional oval nickel anodes; therefore, it eliminates spear forming and "necking." A higher current density can be used without burning, and the ribbed center section is designed to protect the drilled and tapped area in all anodes.

Univertical Corp, 14841 Meyers Rd, Detroit 27, Mich

MORE DATA? Circle 111, inside back cover

High Temperature Refractory Has Resistance to Heat, Salt

Crystolon "63", a new high temperature refractory, is expected to have wide application as a relatively low cost structural ceramic which is high in physical strength and resistance to attack by heat and molten salt. It has already been used experimentally as a lining in aluminum reduction cells and test results indicate that wall thickness of the cell linings can be reduced about 75%. In addition, substantially less electric power is required to operate the cell.

Crystolon 63 is a silicon nitride bonded refractory. While it was originally developed to meet the need for better refractory linings for aluminum reduction cells, it is suitable for use in such other applications as melting and alloying high purity, expensive metals; transferring molten materials; as structural ceramic for package boilers, incinerators, and in kiln furniture for the ceramic industry. It is even being evaluated for use in rocket nozzles and blast pads at launching sites.

Norton Co, Worcester 6, Mass

MORE DATA? Circle 112, inside back cover

New Greaseless Lubricant, in Powder Form, Made From Teflon

A new dry greaseless lubricant, called Poly-Powder, which can be sprayed onto sliding surfaces or moving parts, is manufactured from pure Teflon, the same material now being used to make self-lubricated "permanent" bearings. This lubricant is completely odorless, colorless, tasteless, and non-staining.

This Poly-Powder has the lowest coefficient of friction on any solid material—only 0.016 to 0.024 against polished steel surfaces—and operating temperatures range from –450 to 400 F. It is a universal lubricant which can be used on wood, metal, rubber, plastics, leather, glass, and many other materials, over very broad operating conditions.

This material is furnished in 1-, and 4-oz plastic spray bottles for consumer use and in 4-oz bottles and bulk packages for commercial and industrial applications.

Polydoris Products Corp, 5306 W Lawrence Ave, Chicago 30, Ill

MORE DATA? Circle 113, inside back cover

3M Mechanical Plating System Eliminates Hydrogen Problem

A new method of plating metal parts for corrosion protection, which includes all necessary materials, eliminates hydrogen embrittlement as a problem in plating high-strength steel. A comparatively low capital investment is required, and the system can be operated at lower costs than other plating methods.

The new method, tradenamed Dyko and called the Mechanical Plating System, is primarily designed for applying protective metal coatings, and has been licensed to a limited number of selected plants in the fastener, spring, and powder metallurgy industries in the north central and eastern states. Development work toward broader applications of the system is underway, the company says.

Minnesota Mining and Manufacturing Co, 900 Bush Ave, St Paul 6, Minn

MORE DATA? Circle 114, inside back cover

MORE CUTS PER WHEEL MEAN *"MORE USE PER DOLLAR"*

With Faster, Cleaner MANHATTAN CUT-OFF WHEELS

Every Manhattan Cut-Off Wheel is custom-bonded for the specific cut-off job—whether you work with hardened or soft steels, light gauge tubing, or critical alloys. And custom bonding means safe, fast, clean, cool cutting over sustained periods . . . saves you both time and money. Recent Manhattan developments in both rubber and resinoid bonds assure this greater cutting efficiency . . . and longer life for the wheels.

Manhattan Cut-Off Wheels are manufactured to meet your requirements in the widest range of types and sizes. Manhattan Abrasive Wheel engineers will assist you in selecting the exact construction to improve cut-off operations at your plant. They'll show you how you can save time and money . . . get "More Use per Dollar" . . . with Manhattan Cut-Off Wheels and other types of high speed, heavy duty wheels.

RM-1089

WRITE TO ABRASIVE WHEEL DEPARTMENT

MANHATTAN RUBBER DIVISION • PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

RM

ENGINEERED RUBBER PRODUCTS ... MORE USE PER DOLLAR

Landis 6-in. Grinder, With Numerical Control, Does In-Process Sizing of Work

In addition to controlling wheelhead position and positioning the worktable, this new 6-in. plain grinder uses the third axis of its numerical control system to do in-process sizing of the workpiece. At the Machine Tool Exposition, where it was introduced, the grinder was automatically grinding four different diameters of a motor shaft. The operator simply loads the workpiece and presses a cycle start button; all other functions are controlled by tape.

The new machine, which is equipped with a Warner & Swasey Probomat numerical control system, holds size and uniformity to ± 0.0001 in. Stock removal is 0.015 in. and the grinder gives a 15-microinch finish.

A newly developed gage permits the in-process sizing of various diameters under tape control. At the end of a slow grinding feed, and after a timed sparkout, the Microfeed system begins to advance the wheelhead in increments until finished size is reached. This is indicated by the new in-process gage.

The tape control presets the trip point of the electronic gage and moves it into operative position on the workpiece during the grinding cycle. When size is reached, the gage causes the wheelhead to retract. This cycle is repeated automatically for each different diameter of the shaft.

This new 6-in. grinder may also be used as a conventional plain machine by turning a selector switch which makes the numerical control inoperative.

Landis Tool Co, Waynesboro, Pa

MORE DATA? Circle 51, inside back cover

Pushbutton Press Brake Control Said to Increase Production 50%

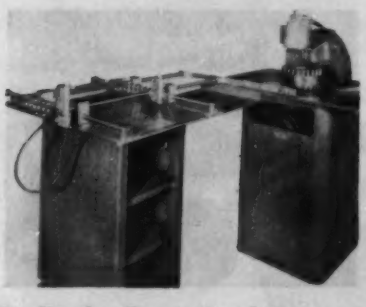
Autobend, a pushbutton control system which can be easily installed on any friction-clutch press brake, is claimed to eliminate rejects and increase production as much as 50% because it substitutes for an operator's skill at the pedal.

The system includes a stepless speed control from a small fraction to 100%; this permits peaking to the maximum bending speed that the work will allow. The higher productivity is the result of the system's ability to run the machine at optimum speed without whipping the work.

Installation on any size and model press brake requires no major changes. The cost—of $2000 to $3000—includes control panels, ram-positioning switch, actuator, speed sensor, and electric pedal.

General Automation Corp, Dept A-9, 40-66 Lawrence St, Flushing 54, N Y

MORE DATA? Circle 52, inside back cover



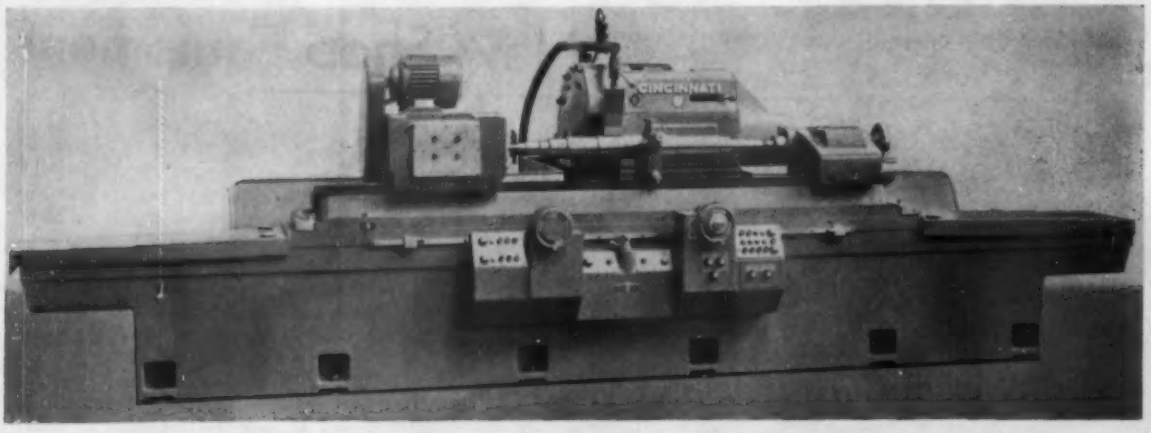
Duplicating Turret Punch Press Handles 24½ x 18½-in. Templets

This duplicating turret punch press combines a modified Model 18-AH or 18-BH power operated turret punch press with a precision duplicating table. It enables operators to punch short and medium production runs of panels, chassis, and other light metal fabrications faster, more accurately, and most important, at lower cost than with other methods, according to the manufacturer.

The duplicator handles templets up to 24½ x 18½ in. Its tabletop is ground aluminum tooling plate drilled and tapped for accurate and convenient templet location. Stylus and actuator buttons are incorporated in gripper handles which insure easy control of stylus.

Rotex Punch Co, 2350 Alvarado St, San Leandro, Calif

MORE DATA? Circle 53, inside back cover



Cincinnati Introduces 18 x 72-in. Tape Controlled Grinder

At the Machine Tool Exposition in Chicago, Cincinnati's Grinding Machine Division introduced their two-axis, numerically controlled center-type cylindrical grinder. This machine, which has a capacity of 18 in. x 72 in. between centers, is controlled by the company's Acramatic control system.

The two-axis absolute system controls the sequence and type of operation to be performed, table reversal points, table and wheelhead movements, truing of a pre-determined amount from the grinding wheel, and cycle stops.

For occasional jobs which do not justify tape preparation, the desired diameter can be manually pre-selected; the operator then presses the cycle start button and the diameter is automatically ground to the preset size. The machine can be used for traverse or automatic infeed grinding, completely independent of tape.

Wheelhead and table are moved by electro-hydraulic servo controls; a 2 hp motor drives the headstock, while a 20 hp motor powers the grinding wheel. Handwheels, control levers, and electrical buttons are arranged for operator convenience.

The Cincinnati Milling Machine Co, Grinding Machine Div, Cincinnati 9, Ohio

MORE DATA? Circle 54, inside back cover

Thomson Makes Ball Bushings Down to ⅛-in. Shaft Diameter

Because of the military demand for miniaturization, Thomson has developed all bushings, designated INST-258 and INST-396, for use on shaft diameters of 0.1246 and 0.1871 in. They weigh 0.15 and 0.30 oz respectively.

Despite small size, each bearing contains three complete ball circuits with each circuit containing 16 or 17 balls, depending on size. Fabrication of precision ball circuits in this miniature size was made possible by the development of special milling techniques, using a 16 to 1 pantograph ratio.

Where required, shafts having a surface finish of 2 to 4 rms are supplied, individually fitted to bushings to provide clearance of 0.0001 in. min and 0.0003 in. max. Shaft materials are either stainless steel or 52100. The material of the sleeve and balls is the same; the ball retainer ring is made from brass.

Thomson Industries, Inc, Manhasset, N Y

MORE DATA? Circle 55, inside back cover

Low Cost Optical Comparator Offered in Portable Model

This portable optical comparator, which has a 20x achromatic, color corrected lens, sells for only $350, fob No Hollywood. It uses standard 1- or 2-in. dial indicators, which are not included in the list price.

Other features are: 8-in. dia screen surrounded by a 1 to 180° protractor with vernier scale; fiberglass molded case; measuring stage with 3 x 3-in. horizontal and vertical travel and ½-in. focusing.

Micro-Vu, North Hollywood, Calif

MORE DATA? Circle 56, inside back cover

GE Jumbo C Ignitron Boosts Size C Welder Output by 50%

A new Jumbo C ignitron permits a 50% boost in power output of standard size C welders without increasing equipment dimensions. Electrical capabilities of the new tube, type GL-7681, are midway between those of the size C (GL-5552A) and size D (GL-5553B) welding ignitrons. While the Jumbo C tube is slightly longer than the size C, its diameter is the same.

In ac control service, two of the new tubes, in inverse parallel, control 1800 KVA with a corresponding anode current of 113.5 amp. With a maximum anode current of 210 amp, the corresponding max demand is 600 KVA. The GL-9681 is rated at

600 volts rms for these capabilities.

The tube is available from inventory at an original equipment manufacturer price of $125.16. It carries the standard H-12 warranty.

General Electric Co, Schenectady 5, N Y

MORE DATA? Circle 57, inside back cover

DoAll Continental Production Saw Doubles Cutting Rates

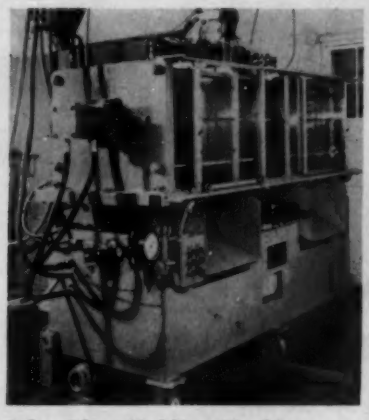
This Continental production saw, which uses the latest types of two-in. wide saw band, delivers higher cutting rates than hitherto were possible; in fact, according to the manufacturer, it doubles rates in production jobs where cutoff plays a large part.

The saw is driven by a 10 hp motor drive, and has a capacity of 16 x 20 in. Features include electrically programmed stock indexing, micrometer length adjustment, automatic chip disposal, overhead mounting of main and outboard vises, servo-regulated cutting rate, planetary chip brush, and standardized worktables.

Guides, which are self-adjusting for work of any size within the machine range, automatically move with the vise jaws and are always at the best position during the cutting.

The DoAll Co, Des Plaines, Ill

MORE DATA? Circle 58, inside back cover



Atlas Blow-Molding Machine Works Completely by Hydraulics

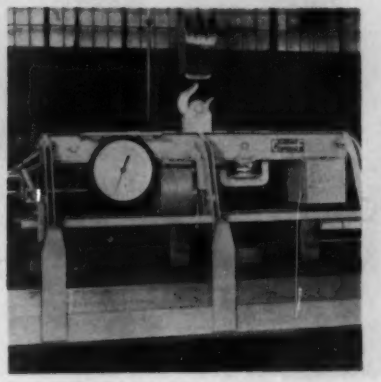
This new blow-molding machine uses air only for the actual blowing operation; all other controls, even the the manifold valve which directs the flow of plastic to alternate heads, are hydraulic.

Cushioned closure is achieved with a two-stage hydraulic system. First, a low-pressure pump closes the mold at a high rate of speed to within the last ½ in. of platen travel; then, with the plate practically stopped, the mold closes smoothly and a high-pressure pump applies clamping pressure.

Two models are available: the JR100 has a 13 x 12-in. molding area, max stroke of 4¼ in., max daylight of 20 in., and 2 to 4 molds; the SR100 has a 26 x 24-in. molding area, max stroke of 5¼ in., max daylight of 30 in., and 2 to 8 molds. Both models can handle products up to 36 in.

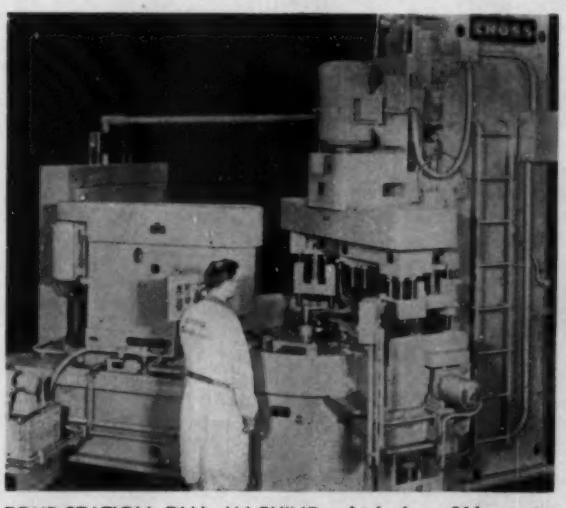
Peuchen Engng Corp, Basin Rd, PO Box 3164, Wilmington 4, Del

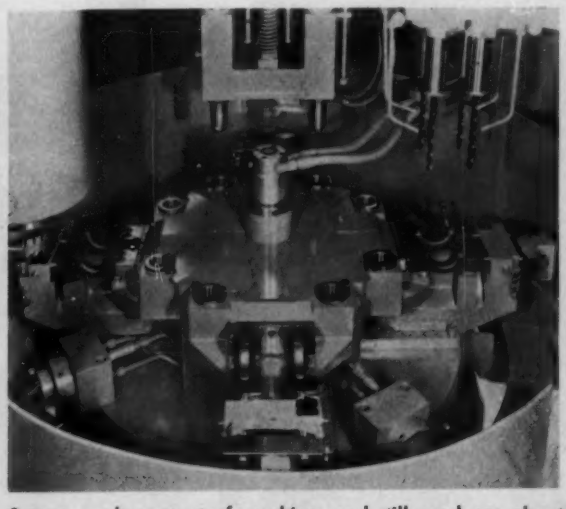
MORE DATA? Circle 59, inside back cover



BUILT-IN HYDRAULIC weighing attachment, which automatically indicates weight of each load lifted, is said to be unique in sheet-lifter field. It requires no headroom as do conventional crane scales—*Martin-Decker Corp, 3431 Cherry Ave, Long Beach 7, Calif*

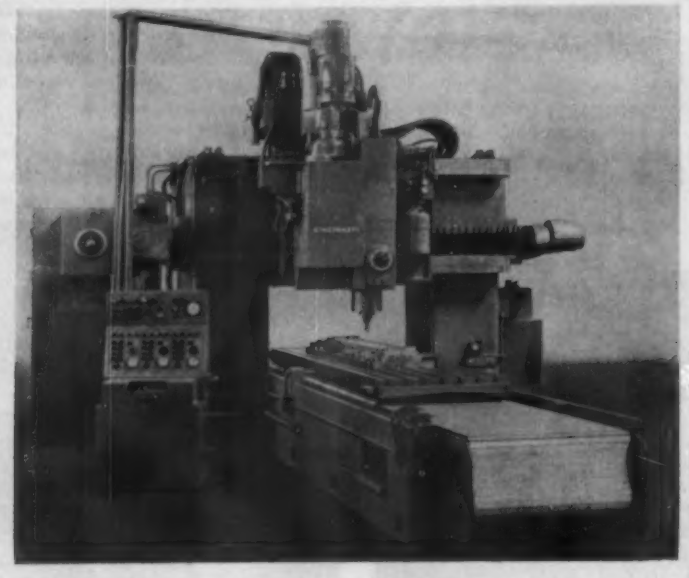
MORE DATA? Circle 60, inside back cover





FOUR-STATION DIAL MACHINE—which has fifth station off dial—mills, drills, and spot-faces two different sizes of rear-axle carrier-bearing caps. This new design approach gives operator more time to load and unload fixtures, reduces cost of machine, and still produces about 262 parts an hr at 80% efficiency—*The Cross Co, Park Grove Station, Detroit 5, Mich*

MORE DATA? Circle 61, inside back cover



Cincinnati 36 x 120-in. Bridge-Type Mill Does N/C Profiling and Contouring

This new bridge-type profile and contour milling machine is designed for automatic, numerically controlled production of medium to large sized parts of complex shapes, and for a wide variety of die-sinking operations. Because it has a 20 hp spindle drive, and 24 spindle speeds ranging from 30 to 3000 rpm, it is suitable for milling of steel, aluminum, titanium, and the new exotic metals to come.

The machine has a bridge-type structure, with the vertical spindle mounted in a cross feeding carrier on the horizontal cross-rail. All feeds are actuated by hydraulic motors; cross and vertical feeds are driven by precision ball bearing type leadscrews, and table feed by rack and pinion with an anti-backlash drive box. Because the table driving pinion is located closely under the cutter, compressive effects are minimized and unaffected by the length of table travel.

Control of the machine is with the three-axis Acramatic contouring system, which is fed with standard decimal-binary coded, 8-track, one-inch perforated tape. Punched card type data input is available if desired. Parabolic interpolation, an Acramatic feature which fits a parabola to the desired curve, rather than trying to use straight-line approximations, greatly reduces the number of calculations and the amount of input data which must be processed. This makes manual calculations, with a desk calculator, feasible when a general purpose digital computer is not available. Computer routines, to simplify programming, can be supplied.

An auxiliary coding feature of the control system, called Acandec, provides smooth starts and stops on either straight lines or curves with a single code. Also, a feed rate override control allows the operator to make instantaneous adjustments of feed rate to suit cutting conditions without having to change the programmed feed rate. In addition, this control permits the operator to stop the machine smoothly at any point in the cycle.

An especially useful feature of the control system is the cutter diameter compensation, which allows the use of resharpened cutters, or cutters of different diameter, without making a new tape program. A simple, direct alignment system is provided using two directional error lights for each axis. The operator simply turns the handwheel in the direction the lights indicate, and, when both lights go out, that axis is properly aligned.

The Cincinnati Milling Machine Co, Special Machine Division, Cincinnati 9, Ohio

MORE DATA? Circle 62, inside back cover

Small Center Lapping Machine Laps Both Ends at Same Time

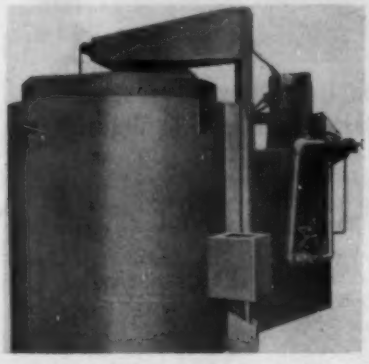
A new center lapping machine, which was designed especially for the lapping of centers in small parts, makes it possible to lap standard as well as recessed center holes from 1/16-in. dia and larger. The machine has two opposing precision high-speed spindles which are individually driven by 10,000 rpm motors with reversible switches.

One spindle is mounted on ball ways to permit a gentle lapping motion. Because the workpiece is held in two adjustable V's, center holes can be offset in relation to the diamond lap.

Other features include interchangeable diamond-impregnated center laps, and mist coolant mounted in position for cooling and cleaning the laps and centers.

J & S Tool Co, Inc, 87 Dorsa Ave, Livingston, N J

MORE DATA? Circle 63, inside back cover



Pit Type Air Draw Furnace Has 1350 and 1700 F Temp Ranges

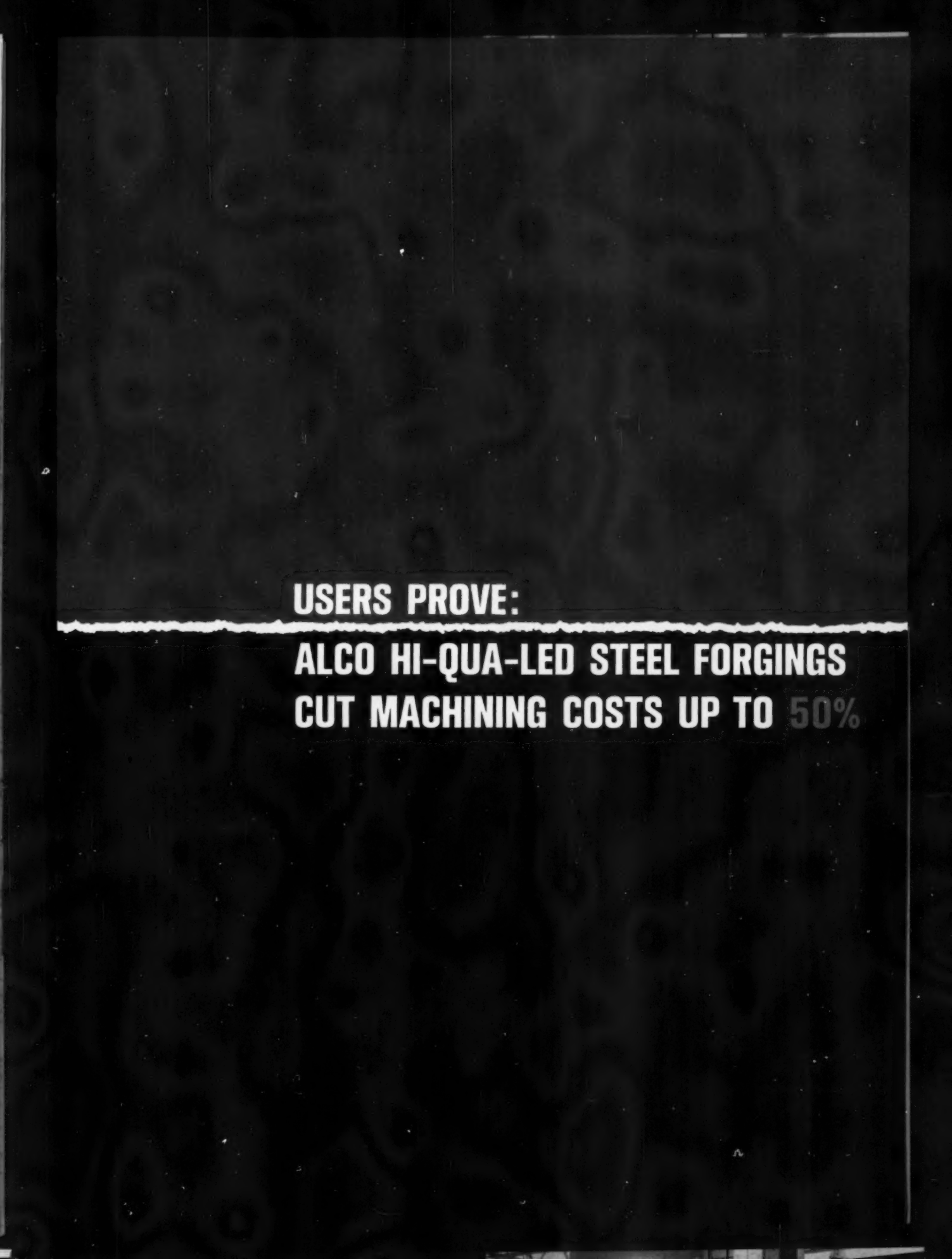
Gas-fired or electrically heated heat treating furnace called the Rotair is designed to meet severe operating conditions and provide accuracy in lower range heat treating. A convection furnace, it heats air in a combustion chamber and then circulates it through the loaded furnace chamber. Two temperature ranges are available; one provides a maximum of 1350 F, the other 1700 F.

Carefully controlled combustion equipment or electric heating units maintain loads at specified treatment temperatures. A high-speed fan rapidly circulates heated air at a high static pressure to quickly bring the furnace up to operating temperature; fast, thorough heating is achieved even in dense loads. Parts may be suspended, fixtured, or placed in baskets for treatment. Top loading allows easy access with an overhead crane and enables lengthy shafts or heavy parts to be placed, suspended, and removed rapidly.

Hevi-Duty Electric Co, Milwaukee 1, Wis

MORE DATA? Circle 64, inside back cover

CIRCLE 252 READER SERVICE CARD ►


USERS PROVE:
ALCO HI-QUA-LED STEEL FORGINGS
CUT MACHINING COSTS UP TO 50%

ALCO

how three leading companies save money with ALCO Hi-Qua-Led steel forgings

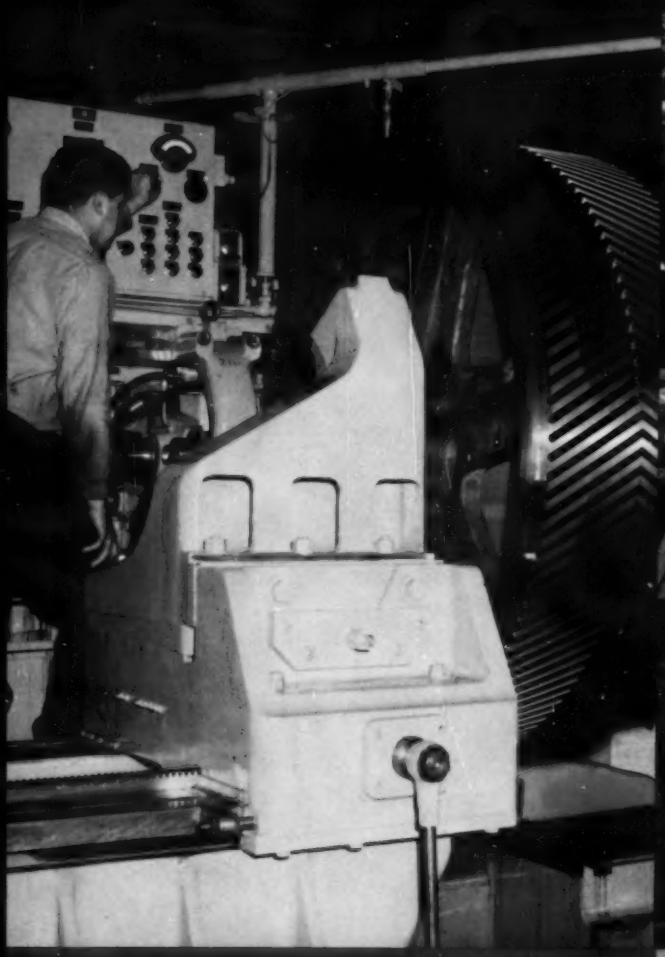
case report:

HI-QUA-LED FORGINGS CUT MACHINE TIME 45%

THE TOOL STEEL GEAR & PINION CO., Cincinnati, achieves large savings in gear-machining operations with ALCO's Hi-Qua-Led Steel forged and rolled rings. On one gear ring, for example, Tool Steel reduced turning time 22% before hardening, and 42% after hardening. Gear hobbing time was cut 43%, rebore 45% and key seating 50%. Average time reduction was 45%.

Hi-Qua-Led forgings machine this easily because of a lead additive which increases shear angle and reduces tool friction. Result: heavier cuts and higher cutting speeds. Expensive tooling lasts longer—five, 10, even 100 times longer.

These big savings are only part of the story. Because Hi-Qua-Led forgings have the same mechanical properties as regular forgings of the same grade, Tool Steel can stand squarely behind its unique guarantee: "Any deficiency made good by cash or new materials."



case report:

HIGHER QUALITY GEARS FOR THE SAME COST

LUFKIN FOUNDRY & MACHINE CO., Lufkin, Tex., uses Hi-Qua-Led forged and rolled rings for 60 in. diam. herringbone gears in its large oil-well pumping units. Previously, cast rings had been used.

Lufkin F&M finds that, although the Hi-Qua-Led rings' price is higher, their machinability cuts the cost of the finished fabricated gear to that of the cast gear. Lufkin is thus able to put a better, more uniform gear in its pumping units for the same cost and provide improved equipment and higher value to its customers.

The table below shows how Hi-Qua-Led rings reduced machining costs at Lufkin F & M.

HI-QUA-LED RING vs CAST RING			
OPERATION	CASTING	HI-QUA-LED	HI-QUA-LED SAVINGS
Turning	20 hours	8.1 hours	59.5%
Shape Teeth	80 hours	60 hours	25%
Tool Expense	$75.00	$25.00	67%

case report:

INCREASED CAPACITY WITH NO ADDITIONAL INVESTMENT

WARNER & SWASEY CO., Cleveland, uses Hi-Qua-Led open-die forged bars for the pentagon-shaped tool holders in their 2AC and 3AC automatic chucking machines. It adopted Hi-Qua-Led for this job three years ago, because it found that machining speeds on every operation—turning, milling, sawing, trepanning, grinding and drilling—could be increased by at least 50%.

The decrease in machining *time* Warner & Swasey gets is about 3 hours per forging. This compensates for the extra cost of Hi-Qua-Led. But Warner & Swasey reasons that Hi-Qua-Led actually expands its production capacity, without any added investment in factory or tools. This is worth about $60 per forging, according to Warner & Swasey figures.

ALCO

ALCO HI-QUA-LED STEEL FORGINGS RAISE PROFIT WITHOUT LOWERING QUALITY

While lowering machining costs, ALCO Hi-Qua-Led forgings have the same mechanical properties as regular forgings of the same grade. "In use" tests show that tensile strength, impact, fatigue and other properties are unchanged. Further, ALCO's exclusive patented lead-addition process guards against lead inclusions or segregates. You get the high quality you expect in custom-forged material.

Hi-Qua-Led Steel rings and forgings are furnished in any steel analysis. If you wish, ALCO will make up your order of regular forgings and include in it a Hi-Qua-Led forging, at no extra cost, for ALCO-supervised tests in your own plant. ALCO Products, Inc., Dept. 1501, Schenectady 5, N. Y.

SIZES AVAILABLE

OPEN DIE FORGINGS—RECTANGULAR
Maximum width—32 in.
Maximum height—32 in.
Maximum length—40 ft
Maximum weight—36,000 lb
Minimum weight—1,000 lb

MANDRELLED RING FORGINGS
Maximum OD—82 in.
Minimum OD—24 in.
Maximum width—60 in.

OPEN-DIE FORGINGS—ROUNDS
Maximum OD—36 in.
Maximum length—40 ft
Maximum weight—36,000 lb
Minimum weight—1,000 lb

ROLLED RING FORGINGS
Maximum OD—160 in.
Minimum OD—18 in.
Maximum width—24 in.

ALCO FORGINGS

ALCO PRODUCTS, INC.

Heating Costs *Cut In Half*

with TOCCO* *Induction Heating*

Engineers at Thompson Products Michigan Division of Thompson RamoWooldridge, Inc. recently changed from gas-fired furnaces to fully automatic TOCCO. Application: heating for forging of automotive tie rods. Result: a substantial reduction in direct labor costs, saving thousands of dollars a year on this heating for forging operation. *Annual savings actually amortize the cost of the TOCCO installation in about one year.*

The automotive tie rod shown here is only one of over 500 parts heated for forging in Thompson's new, modern forge plant. *Every one of these parts is heated with TOCCO equipment.*

If *your* manufacturing operations require heating for forging, heat treating, brazing, soldering or melting, it will pay you to investigate TOCCO as a sound method of increasing production and lowering costs.

THE OHIO CRANKSHAFT COMPANY

Mail Coupon Today— NEW FREE Bulletin

The Ohio Crankshaft Co. • Dept. B-10, Cleveland 5, Ohio

Please send copy of "Typical Results of TOCCO Induction Heating for Forging and Forming".

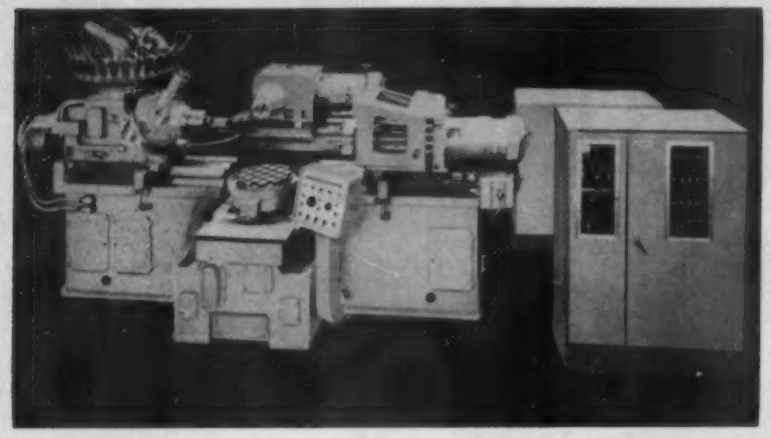
Name_____

Position_____

Company_____

Address_____

City_____ Zone____ State_____



Hughes 3-Station 'Machining Center' Has Tape Controlled Heads, Positioning Table

This three-station, numerically controlled machine tool—which, according to the company, "brings production line efficiency to batch lot production"—takes face and other milling cuts as well as drills, bores, reams and taps. It will handle work pieces as large as a 12-in. cube, and positions to 0.001 in., with an accuracy of ±0.0005 in.

The major parts of the machine are manufactured by the West German firm of Burkhardt & Weber. They are shipped to the US for assembly, however, and all controls and drives, as well as the complete numerical control system, are manufactured by the Industrial Systems Division of Hughes.

Designed on the building block principle, this MT-3 has a central positioning table surrounded by three tape controlled work heads:

- a universal drilling, tapping, and boring head which has a storage capacity for 30 tools and which changes tools in less than three seconds;
- a face milling head;
- a multiple spindle drill head or a precision boring head with a 14-tool capacity changer.

The MT-3 may be purchased without the third head if individual manufacturing requirements do not call for it.

A Hughes electronic numerical control system directs the operation of the MT-3 Machining Center, and does point-to-point positioning in increments of 0.001 in. Transposition of engineering information from drawing to control tape is done with an inexpensive tape preparation unit which does not require a computer.

The company claims that the MT-3 is particularly suited to the manufacture of lot quantities in the range of 5 to 500 parts.

Hughes Aircraft Co, Industrial Systems Div, PO Box 90904, Airport Station, Los Angeles 45, Calif

MORE DATA? Circle 65, inside back cover

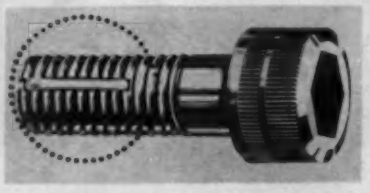
Furnace With 1-in. Insulation Heats to 1900 F in 25 Minutes

Being introduced at the Philadelphia Metal Show, this new electric furnace develops up to 1500 F in less than 16 minutes from ambient, and 1900 F in 25 minutes. Although it is only one-in. thick, the new insulation—Du Pont's Tipersul—has greater shielding properties than three to four inches of normal firebrick.

The model shown above has a fully automatic indicating-controlling pyrometer, an optional feature, for accurate chamber temperature control. A pilot light indicates pyrometer operations. The furnace, which is completely portable, operates on only one-half the wattage of comparable sized furnaces.

The Electric Hotpack Co, Inc, Cottman Ave at Melrose St, Philadelphia 35, Pa

MORE DATA? Circle 66, inside back cover



Parker-Kalon Shows New Line Of Socket Screws With Inserts

A new line of P-K socket screws with plastic inserts is being shown at the Philadelphia Metal Show. The company points out that this new line does not replace the present socket screw line; rather, it is a companion line to it.

Called Long-Lok, this new self-locking insert on P-K socket screws performs over a wide range of temperatures. In aircraft and missile application it has already proven its ability to withstand impact, shock, and most rugged environmental conditions. In industrial use in automotive, components and assemblies, engines, tools, and heavy machinery, the screws reportedly give superior thread engagement, high torsional resistance, and a self-locking drag.

Parker-Kalon, Div of General American Transportation Corp, Clifton, N J

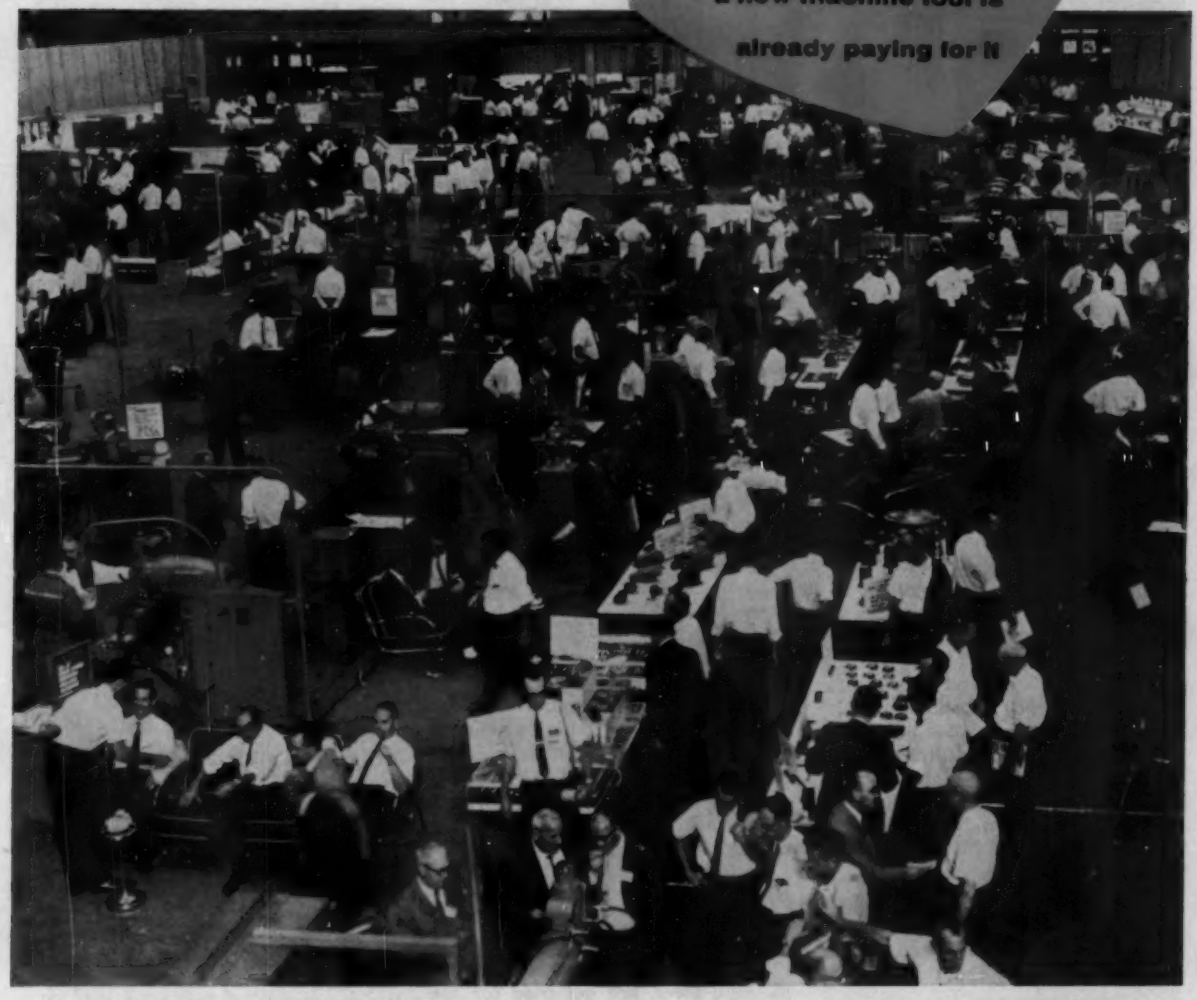
MORE DATA? Circle 67, inside back cover

MICROFLEX TOOL HOLDER gives positive adjustment of finer finish cuts to 50 millionths of an in. Designed for use on second operation and chucking machines, it will also hold boring tools on jig borers, screw machines, and milling machines. Holder is recommended for production tolerances less than 0.0005 in.—*Hardinge Brothers, Inc, Elmira, N Y*

MORE DATA? Circle 68, inside back cover

JONES & LAMSON MACHINE COMPANY

the man who needs a new machine tool is already paying for it



If you don't buy now . . . You'll pay later

You can bank on it. If you don't buy new production equipment now, you *surely* will pay later, and the price will be high in more ways than one.

The recent Machine Tool Exposition in Chicago demonstrated beyond a doubt that production economics *and* production techniques are undergoing rapid and sweeping changes.

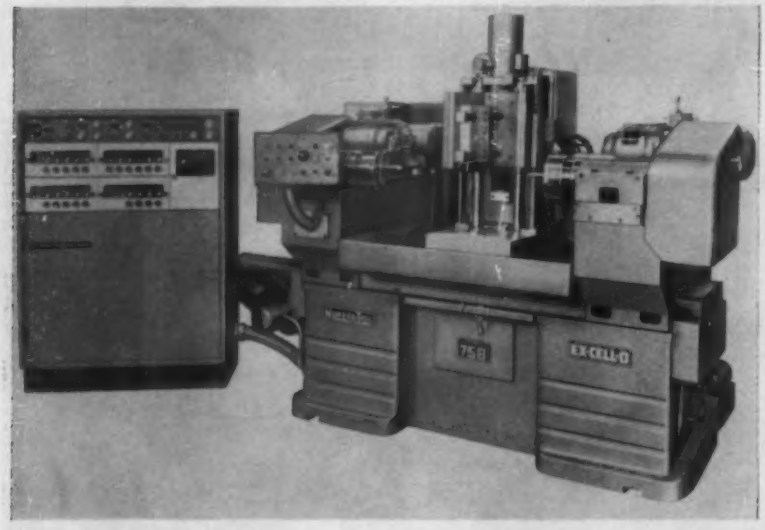
As a result, production management is faced by two big jobs, 1.) Deciding *which* items of new, advanced equipment are best suited to individual plant requirements, and 2.) convincing top management that this new equipment *must* be acquired, and that it can be paid for easily in a way best suited to your needs.

Jones & Lamson can help you with this twofold problem. First, the new J&L line of machines is broad in application over a great variety of operations. Second, these machines will pay for themselves out of Profitivity®, and can be leased at an hourly rate of $2.50 per $20,000 of machine value: There's no advance payment, and the hourly rate drops to 12½¢ after five years.

Literature telling about the machines, how to justify their purchase, and how to pay for them, is yours for the asking.

Write to Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



Ex-Cell-O Tape Controlled Boring Machine Changes Hole Dia Plus Depth and Location

Actual four-axis machine control—not only positioning the work in relation to the boring tool, but also adjusting the boring tool to the required hole diameter while the spindle is operating—is the big feature of this new double-end boring machine which was introduced at the Machine Tool Exposition. In addition, the incremental Rheem tape positioning system provides control in all axes to increments of 0.0001 in.

Because it has a new type control system, this Model 758 can perform single-point boring operations with infinite center locations and variable bore diameters within the limits of the machine. Accuracy of hole diameter is held within 0.0005 in.; center locations are held within 0.0002 in. of true position; and boring depth is held within ± 0.0005 in.

The special tool control mechanism accepts numerical commands to control the radius of tool rotation; ie, it positions the boring bar to change boring size without stopping the spindle. Programming of infinite boring diameters is possible within a one inch range for each of the boring bar inserts.

Ex-Cell-O Corp, 1200 Oakman Blvd, Detroit 32, Mich

MORE DATA? Circle 69, inside back cover

Pullmax Announces Economy Line Of 5 Shearing-Forming Machines

With prices starting at $400, this line of 5 universal shearing and forming machines does straight, circular and irregular shearing, plus slotting, folding, bending, joggling, edge bending, and louver cutting.

The machines, which have capacities ranging from 14 ga up to 7/32-in. mild steel, are designed for use in sheet metal shops, schools, engineering departments, model shops, and plants where small production runs will eliminate costly dies.

American Pullmax Co, Inc, 2455 N Sheffield Ave, Chicago 14, Ill

MORE DATA? Circle 70, inside back cover

Line of Tappers and Threaders Eliminates Need for Lead Screws

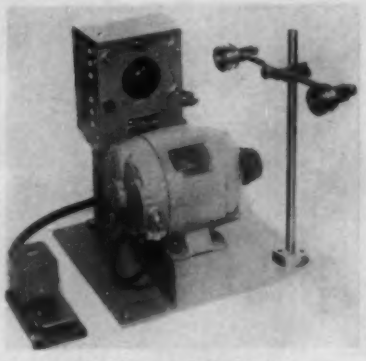
This new line of compact tapping and threading tools is designed to eliminate the necessity of using lead screws or sensitive hydraulic and mechanical feeds on automatic screw machines, multiple spindle drilling machines, and turret lathes.

The new tools have wide capacity ranges and relatively small diameters. For example, the No. 10, ½-in.-capacity tool has a body with a max OD of only 1 in. The use of rubber-flex collets gives each tool a wide tap capacity.

The tools have an axial floating drive spindle, the free movement of which allows taps and dies to determine their own lead; therefore, no machine or operator lead pressure is required.

Tapamatic Corp, 845 W 16th St, Costa Mesa, Calif

MORE DATA? Circle 71, inside back cover



Electronic Motor Drive Unit Has Speeds from 0 to 4000 rpm

Unit contains no tubes, and the motor can be stopped or reversed at any speed; dynamic braking is a standard feature. Two sizes are available; the smaller has a ⅛ hp motor and the larger a 1/3. Foot switch is included and the unit is wired and ready to plug in for 110-v 60-c 1-phase, ac operation. Idler pulley and stand can be adjusted in all directions and will follow the travel of the tools being driven.

F W Derbyshire, Inc, 157 High St, Waltham 54, Mass

MORE DATA? Circle 72, inside back cover

COBALT SUPER HIGH SPEED DRILLS are available in both wire and jobber lengths and in taper shanks. Made of premium T-15 steel, and especially brasion resistant, they are recommended for drilling the newer and harder missile metals—*Union Twist Drill Co, Athol, Mass*

MORE DATA? Circle 73, inside back cover

JONES & LAMSON "AUTOMATION"

the man who needs a new machine tool is already paying for it

Completely automatic turret lathe gives peak production efficiency

J & L's new, completely automatic turret lathe sets a new high standard of efficiency for both bar and chuck work. Now, for the first time, you have the versatility of turret lathe tooling combined with completely automatic operation. All machine functions and sequences are pre-selected and programmed by the operator or set-up man, from a staging panel during initial set-up.

The automatic machine characteristics of this new lathe include fast motion, variable speed selection, spindle speed selection, turret indexing, coolant on and off, bar feed, and cycle stop.

A noteworthy feature is the automatic operation of a 12-speed hydraulic clutch headstock combined with a 24″ saddle motion which is actuated by a closed-loop, two-stage hydraulic servo system.

The cross slide has a 14½″ stroke and drive similar to that of the saddle, and has several automatic cycles, as programmed from the staging panel. Three speed ranges are available: 20 to 1000; 30 to 1500; and 40 to 2000 RPM. Power is from a single speed motor (up to 40 HP). Feed range is from .750″ per minute to 30″ per minute for the saddle, and from .375″ per minute to 15″ per minute for the cross slide.

Send now for our folder on this remarkable new machine. Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vt.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

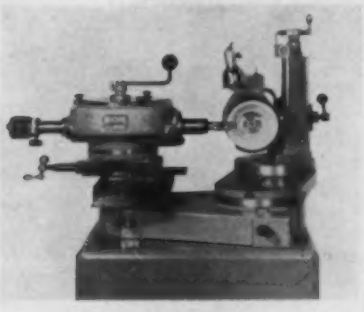
Barrel Tumbling Machines Feature Electromagnetic Vibratory Drives

Powerful, controlled, directional vibration keeps both parts and media agitated and constantly working to assure more thorough finishing of shielded areas. Amplitude of vibration can be instantly varied by rheostat knob on the control box while the same frequency of 3600 vibrations per minute is maintained.

These self-contained units are available in three models with 0.4, 1, and 6 cu-ft barrel capacities; larger models will be available in the near future. Machines incorporate a screen cover and hose connection for flushing out compounds and a screen trough to separate parts and media. The same directional vibration that finishes the parts moves the parts and media across the screen dressing for rapid separation.

Syntron Co, 311 Lexington Ave, Homer City, Pa

MORE DATA? Circle 74, inside back cover



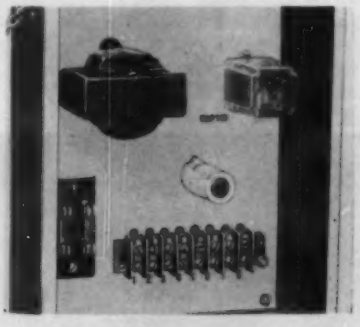
Grinding Machine Processes Wide Variety of Cutting Tools

Multi-Spiral Universal Grinder is designed for grinding standard end mills, fast spiral end mills, taper end mills, taps, reamers, counterbores, core and step drills, angle and side milling cutters, and many other cutting tools.

Spindle capacity is 1¼-in. hole 5¾ in. deep; stroke is 3¾ in.; index spool for 2-3-4-6 divisions. Five bushings are furnished: ⅜, ½, ⅝, ¾, and 1 in. Motor is ½ hp, 115 v, 60 c, 3450 rpm. Price is $1995.

Spiral Step Tool Co, 5400 N Damen Ave, Chicago 25, Ill

MORE DATA? Circle 75, inside back cover



Clark Introduces Electronic Relay With High Sensitivity

Called the Bulletin 5104 Electronic Finger, this highly sensitive electronic relay requires only a few microamperes of current for operation. The device will actuate any electrically controlled function of a process or a machine, such as size or position control.

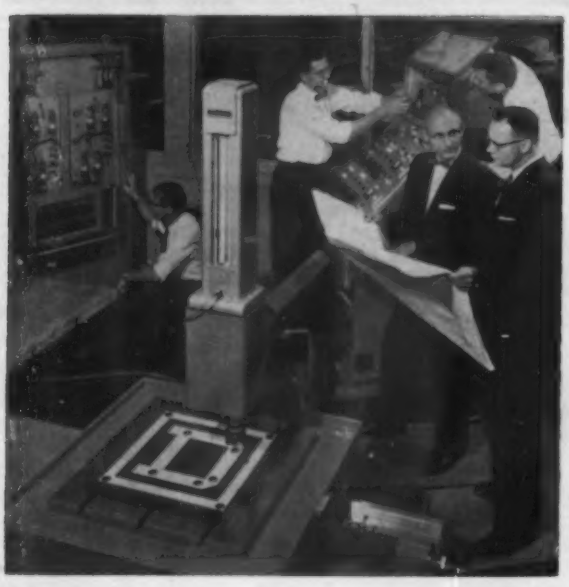
The finger, which responds in 0.02 sec, can be actuated by only 50 microamps. Unshielded leads up to 100 ft long can be used to connect probes to control, and an integral time delay is available.

The relay is actuated by grounding an external probe. Because it has a low power requirement, it may be used with grounding materials which have a low conductivity. Current flow through fluids, for example, may be sufficient to operate.

Clark Controller Co, 1146 E 152nd St, Cleveland 10, Ohio

MORE DATA? Circle 76, inside back cover

Square D Positioning Control System Accurate to 0.001 in.



Rapac—a point-to-point tape controlled positioning system—was introduced at the Production Engineering Show. Providing accuracy to ±0.001 in. and repeat accuracy to ±0.0005 in., the system will direct such machine tools as drill presses and boring mills. It is also suitable for multiple axis control.

A linear transducer in the system, which at all times indicates the direction of travel toward the desired positioning point, is said to be subject to neither wear nor deterioration.

Rapac does not require special machine designs; it will operate with virtually any precision machine tool or device requiring accurate positioning. Because Square D static components and encapsulated build-block circuitry have been used wherever possible, maintenance is reduced and simplified. In addition, accuracy is not dependent on screws, racks and pinions, or other parts which are subject to wear.

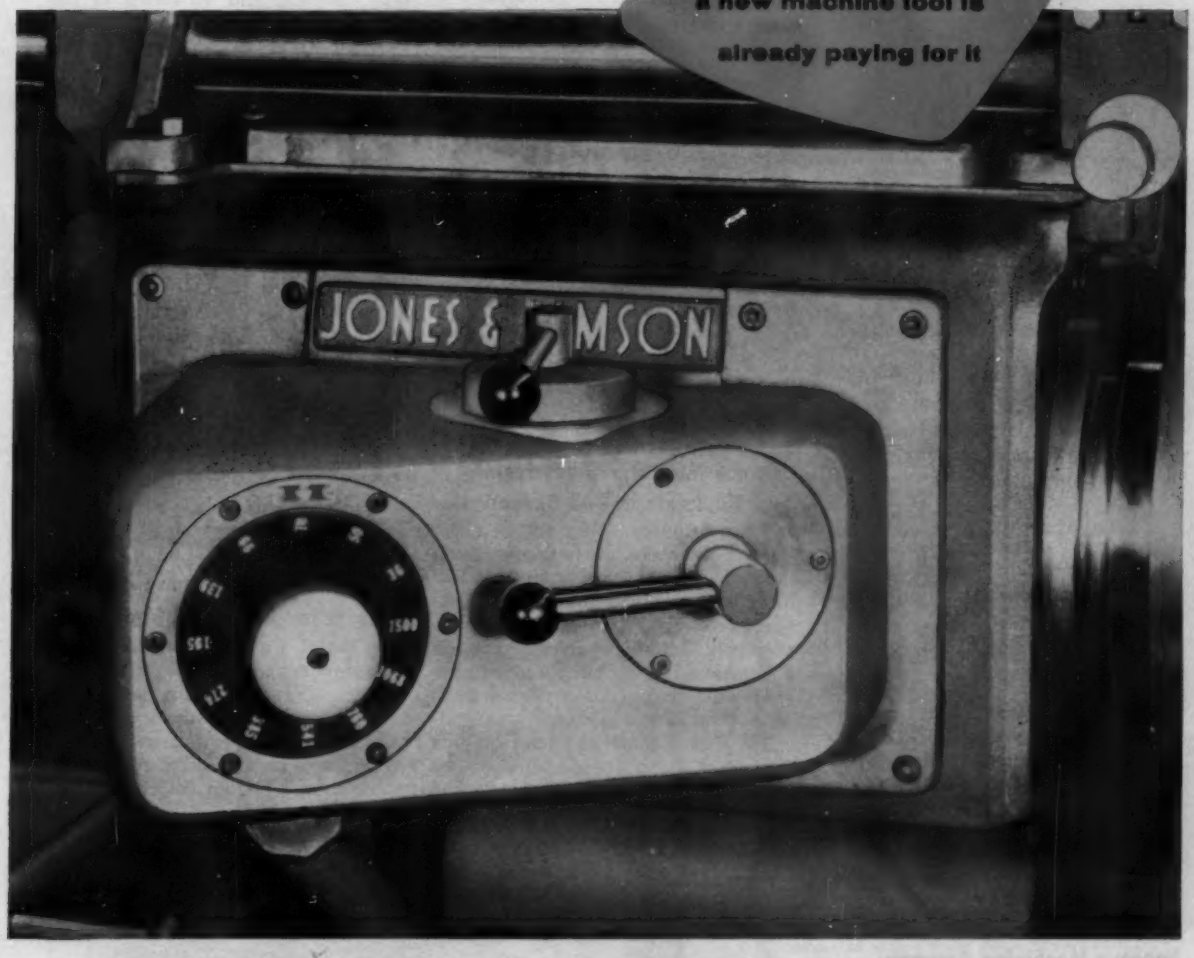
Although it is available as a complete system, Rapac can also be supplied in components for measuring subsystems, drive sub-systems, and data decoding subsystems.

Square D Co, Dept SA, 4041 N Richards St, Milwaukee 12, Wis

MORE DATA? Circle 77, inside back cover

JONES & LAMSON MACHINE TOOLS

the man who needs a new machine tool is already paying for it



New improved design for J & L Ram and Saddle Type Turret Lathes

These two new J & L lathes are *really* new. No mere face lifting here . . . both lathes have been completely redesigned from the floor up!

Both the Ram type and Saddle type lathes are equipped with a multi-speed hydraulic headstock, and are capable of giving you more chips per tool, more pieces per hour, and more profit per job.

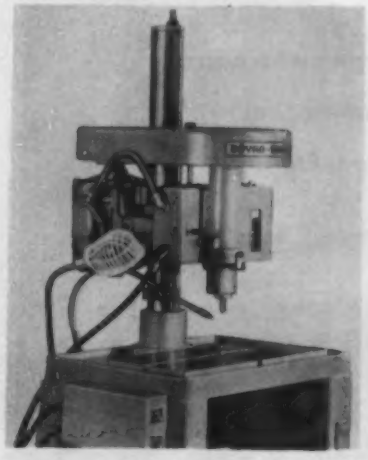
The redesign of these machines starts with 41″ of leg depth for more stable footing. New cross-ribbed bed design provides even greater rigidity for heavy cuts — and gives straight-line chip disposal out the back. The new wide pan includes a built-in accessible coolant tank at the head end of the machine. The new headstock transmits up to 40 HP.

An extremely important feature is the hydraulically operated clutches, which change pre-selected spindle speeds instantly and automatically.

Other features include: motor mounted vertically on the rear of the machine; a new carriage of rugged design, on which the stop spool is more conveniently located; heavy duty aprons which allow the adaptation of full length lead screw threading attachments, as well as the extremely versatile 2-Dimension (180°) carriage tracer; built-in independent pumps, which supply forced lubrication to the aprons, carriage, and saddle.

Both of these new lathes offer more power, greater accuracy, and easier operation. Write today for details. Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vt.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools



Leadscrew Tapping Machine Incorporates New Control

Control circuit that provides full control of tapping motion at all times also permits a choice of jog or complete cycle stroke with conventional foot switch control. Machine responds to either momentary or constant contact of operating switch and will make one stroke only; contact must be broken at the end of the tapping stroke before the machine will repeat.

Full adaptation to automatic or semi-automatic feeding is accomplished through the receptacle for any type of contact switch. Circuit is controlled by plug-in type standard relays.

Boyar-Schultz Corp, 2000 S 25th Ave, Broadview, Ill

MORE DATA? Circle 78, inside back cover

Controlled Mist Spraying Units Improve Machining Accuracy

Unimist metering blocks and tank units provide controlled mist spraying of machining coolants and drawing compounds. Blocks mount on the machine right at the point of application where the operator can control both air and liquid flow exactly and see the results as he adjusts the metering screws. Once the best flow is established, the master on-off plunger takes over; resetting or adjusting is eliminated until a new job is started. Because heat is dissipated uniformly and at the proper rate, tolerances and surface finishes can be efficiently controlled in machining, drawing, and extruding operations.

Spray units operate on low tank pressures, 10 to 30 psi. Standard model has a 2-gal tank with pressure regulator, gage, and safety valve. Tank can be used with multiple metering blocks, or a large number of blocks can be operated from a central system.

Unimist Inc, 510 28th St SW, Grand Rapids 9, Mich

MORE DATA? Circle 79, inside back cover

Contour Measurer Gives Form And Thickness in One Operation

All new Contour-O-Scope—a direct reading universal contour measuring instrument that can simultaneously measure form and thickness in one operation—is said to solve the complex inspection problems of parts and components with multi-faced, spherical, and contoured surfaces with simplicity and ease.

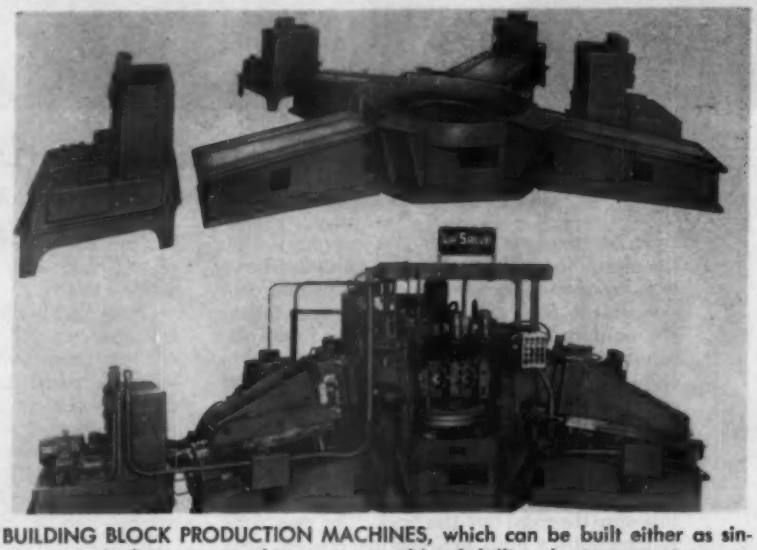
The instrument can check contour dimensional accuracy to 0.001 or 0.0001 in. on machined, cast, or forged parts. It is a measuring instrument which can be used at all stages of complex component development, from the pattern stage to the prototype, tooling, and on down to the finished production inspection. No intricate or time-consuming setups are required to assure accuracy and uniformity of results.

Turbotronics Corp, E 193rd and Roseland Ave, Cleveland 17, Ohio

MORE DATA? Circle 80, inside back cover

Count-O-Matic Elevator Hopper Adjusts for Variety of Sizes

The latest improved model of the elevator hopper, which is a standardized, general purpose hopper equipped with a standard adjustable track with either an escapement mechanism or a transfer mechanism to discharge cylindrical objects in a



BUILDING BLOCK PRODUCTION MACHINES, which can be built either as single- or multiple-station machines, are capable of drilling, boring, reaming, tapping, and related operations. Eight standardized basic components form their nucleus: main base, wing base, wing base adapter, way-type feed unit, quill-type feed unit, horizontal angular adapter, angular column, and vertical column—*LaSalle Machine Tool, Inc, 21535 Hoover Rd, Warren, Mich*

MORE DATA? Circle 81, inside back cover

JONES & LAMSON
OPTICAL COMPARATORS

the man who needs a new machine tool is already paying for it

Unretouched photo (above) shows this cylindrical rack being inspected at 62.25X. Photo, courtesy of Baird-Atomic Inc., Cambridge, Mass.

4000% Increase in Inspection Efficiency through use of a J & L Optical Comparator

Baird-Atomic, Inc., Cambridge, Mass., manufacturer of scientific and research instruments needed a rapid and precise method for the quality control measurement and inspection of various components. After experimentation with various types of inspection equipment, a J & L FC–14 Optical Comparator was given a trial. It met all requirements perfectly.

The inspection of a cylindrical rack, heart of the Baird-Atomic Periscopic Sextant, used in advanced aircraft, gives an illustration of the J & L Comparator's efficiency.

The rigid quality control tolerances for this part include: tooth-to-tooth tolerance, .0002″; tooth-to-tooth error, .0003″; composite error, .0003″; pitch dia. within .0005″; concentricity within .0005″ TIR.

Adequate inspection and measurement by conventional methods proved laborious and time-consuming: inspection rate was little better than one rack per day. Now, using a J & L FC–14 Optical Comparator, average inspection rate is 42 per day, an increase of approximately 4000%!

Investigate the possibilities of J & L Comparators in *your* production set-up. Available in 12 different models, both floor and table types.

Write today for Comparator Catalog 5700. Jones & Lamson Machine Company, 502 Clinton Street, Springfield, Vermont.

Turret Lathes • Automatic Lathes • Tape Controlled Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

rolling position, can be quickly adjusted for a large variety of sizes and shapes. No change-over parts are required.

Other features include a rotary brush at the top of the elevator to prevent parts from carrying over, a joggling action in the hopper to prevent the parts from bridging and to make the hopper self-emptying. The drive is provided with an overload safety clutch to protect the moving mechanism.

Count-O-Matic, Inc, Div of US Engrg Co, 40-24 22nd St, Long Island City 1, NY

MORE DATA? Circle 82, inside back cover

Maxwell Recess Tool Holders Have Shortened Working Section

Designed for tape-controlled or automatic machines which normally have confined areas for tool changes and/or storage, new Model RA recess tool holders feature a working section shortened approximately 40% without sacrificing any of the range. While the travel of the cutter block is less than that of the Model R, this Model RA has greater travel than that normally provided with holders of this size.

Two sizes are now being introduced in the RA series. The No. 1-RA has a working range from ⅛ to 1-in. dia and a travel of 9/32 in. The No. 2-RA has a working range of 1 to 2-in. dia and 5/16-in. travel. The feed-out of the cutter is in ratio of 1:1 to the spindle; therefore no mathematical calculations or interpolations are needed for set-up or cutter design.

Maxwell Industries, Inc, 493 E 5th St, Ashtabula, Ohio

MORE DATA? Circle 83, inside back cover

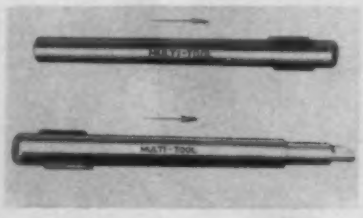
Cleveland Differential Gaging Gives Accuracy to Millionths

A new approach to high precision measurements using simple electronic type gaging equipment eliminates the need for expensive, short life mechanical fixturing. Measurements can often be made under what previously were impossible conditions. With differential gaging techniques, a wide range of measurements are now possible in such areas as: concentricity, roundness, size, diameter, taper, flatness, profile, cam contour, parallelism, squareness, lead screw pitch, and wall thickness.

The basic equipment consists of two identical gage heads and a differential input amplifier.

Cleveland Instrument Co, 737 Carnegie Ave, Cleveland, Ohio

MORE DATA? Circle 84, inside back cover



Counterbore, with Changeable Blades, Cuts in Two Directions

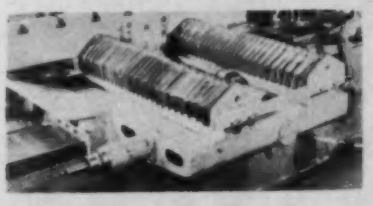
Because it has an interchangeable blade feature, this new counterbore is said to be adaptable to unlimited counterboring and spotfacing applications. A socket set screw secures the blade in a solid, one-piece shank and pilot; a simple adjustment permits quick interchange of blade sizes or replacement.

The blades have spooned cutting edges that cut clean precision holes and eject chips properly; also, practically all materials can be machined. Reverse or back counterboring can be done with reverse ground blades.

Medium duty set ranges from No. 10 to ¾-in. cap screw size. Heavy duty series ranges upwards from ½-in. pilot diameter, in blade sizes suited to customer specifications.

Multi-Tool Co, 14512 Burt Rd, Detroit 23, Mich

MORE DATA? Circle 85, inside back cover

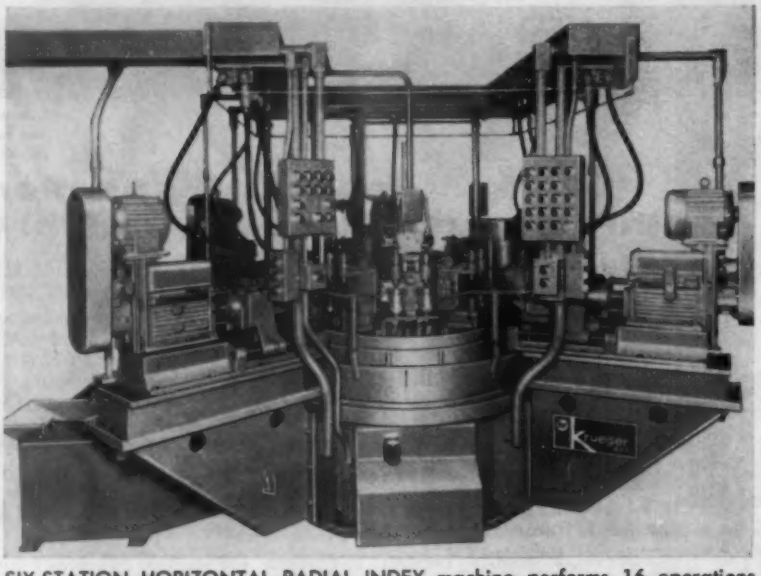


Way Guard Carrier Protects Against Override Problem

Guard protects ways from chips and abrasion on machine tools where table overrides the ways. It protrudes less than 7 in. beyond the table. The guard is picked up by the table and carried free of the ways to the full extent of the table's travel. As the table returns to the extreme opposite position, the carrier engages at the end of the way and the accordion guard is stretched across the way for complete, continuous protection.

Can-Pro Corp, 19 E. McWilliams St, Fond du Lac 2, Wis

MORE DATA? Circle 86, inside back cover



SIX-STATION HORIZONTAL RADIAL INDEX machine performs 16 operations on aluminum automotive pistons during a 13-sec cycle. Handling two pistons simultaneously, machine drills, mills, chamfers, and slit-saws in one continuous operation—*H P Krueger & Co, 1469 E Grand Blvd, Detroit 11, Mich*

MORE DATA? Circle 87, inside back cover

Gleason Works announces automatic gear tester operation through tape control

Electronic tape control on Gleason Production Testers will make your bevel and hypoid gear tester operation an automatic process. Tape controls will allow you to automatically pre-set and vary test factors—direction of rotation, tooth bearing position, pinion spindle speed and brake load—in any sequence you wish.

Once you tape the test sequence, you can repeat it exactly anytime—for the next pair of gears or repeat the set-up months later.

Write us. We will be pleased to send additional information.

GLEASON WORKS

1000 UNIVERSITY AVE., ROCHESTER 3, N.Y.

CIRCLE 261 READER SERVICE CARD

do your plans include mechanized drop forging?

The CECOMATIC Forging Process, based on the revolutionary Chambersburg Impacter, makes possible the continuous and automatic production of precision drop forgings. If you are a manufacturer whose products include drop forged components, you must consider mechanized forging in your plans for the future...your competition will do so—sooner or later. Practical information, with examples of successful mechanized forging operations, are included in the brochure, "The Automatic Production of Forgings in Closed Dies". Write for a copy today, to Chambersburg Engineering Company, Chambersburg, Pennsylvania.

CHAMBERSBURG

DESIGNERS AND MANUFACTURERS OF THE IMPACTER

Heavy-Duty Air Hammer's Design Allows Cutting Tools to Rotate

Model SP-400, with a short barrel, has a beehive spring retainer instead of the usual stationary safety chuck so that the cutting tool can rotate. Designed for heavy-duty rivet busting, riveting, and panel cutting in close quarters, it an also be used for cutting drum lids, punching sheet metal, and breaking spot welds. Trigger controls blows from 0 to 3500 per minute.

Unit weighs 3⅛ lb, measures 7½ in. long, consumes 9-11 cfm at 90 psi.

Superior Pneumatic & Mfg Co, 13800 Enterprise Ave, Cleveland 35, Ohio

MORE DATA? Circle 88, inside back cover

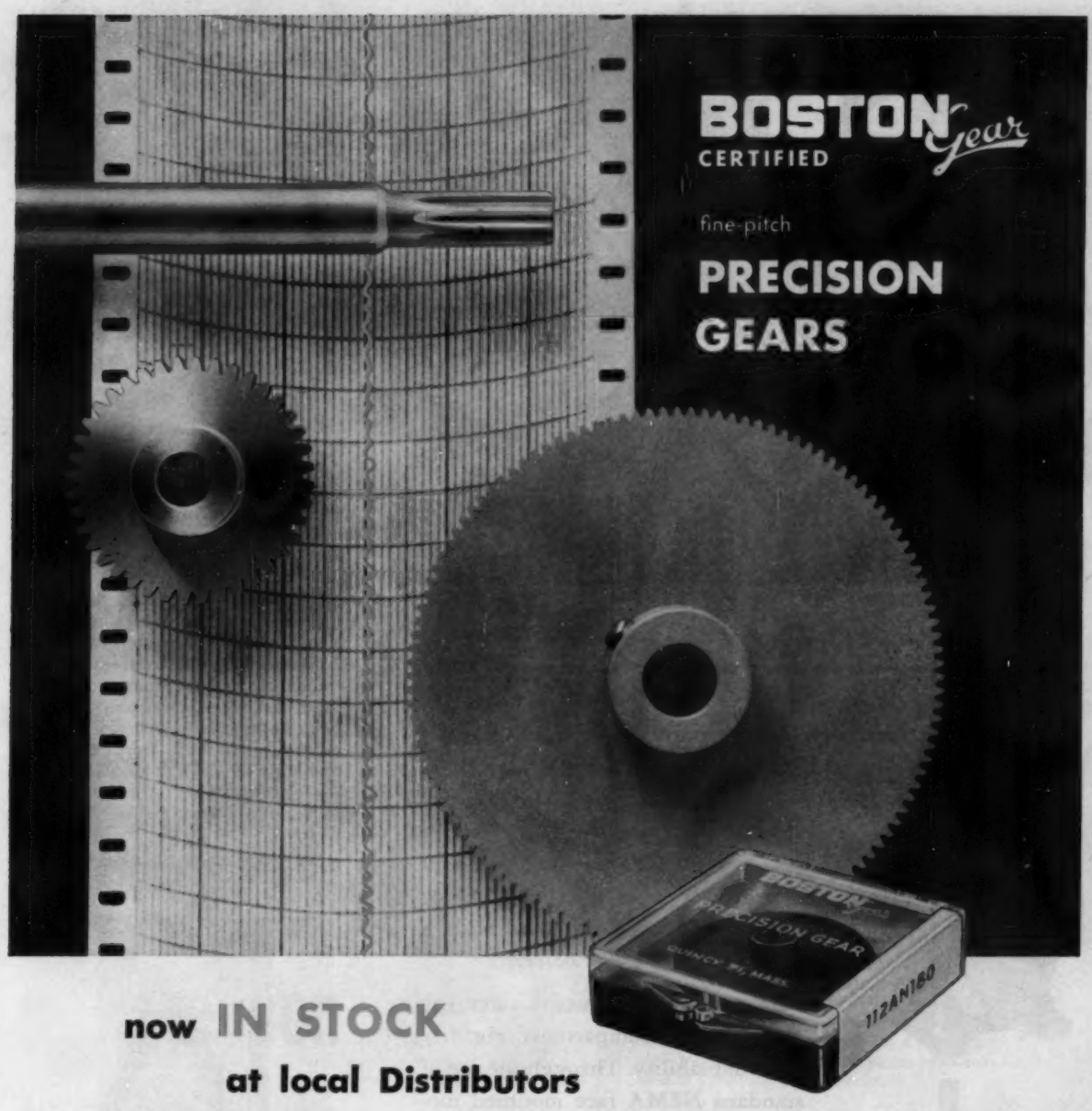
250 oz-in. Synchronous Motor Permits AC Speed or DC Stepping

Permanent magent Slo-Syn type SS250 is designed primarily for heavier duty use. It can be started, stopped, or reversed instantly with a single-pole, three-position switch. When used as an incremental positioning device, dc voltage applied to the field windings converts one revolution of the motor shaft into 200 precise steps. Motor will maintain its rated torque for any stepping position.

Ratings are: input 120 v, 40/70 c, 1 phase, 0.6 amp max current (at 60 c); 72-rpm output speed at 60 c; 250 oz-in. torque. Planetary gear type SS250-P1 is available for applications which require a torque of 650 oz-in. and a speed of 16.6 rpm.

Superior Electric Co, Dept SS, 83 Laurel St, Bristol, Conn

MORE DATA? Circle 89, inside back cover



now IN STOCK
at local Distributors

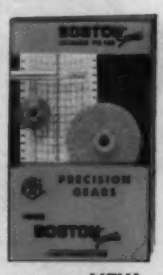
To meet space-age demands for greater accuracy and miniaturization, your BOSTON Gear Distributor now has fine-pitch 20° P.A. PRECISION Spur Gears IN STOCK. Standard sizes range from 48 to 120 D.P. — 10 to 40 teeth in stainless steel, and 42 to 180 teeth in aluminum.

Each Precision Gear is certified by BOSTON Gear to be AGMA Precision Class 1 or better. All materials and finishes conform to Federal and Military specifications.

Precision Gears are individually packaged in plastic containers and are delivered to you factory-sealed for your protection.

Be cost-wise . . . standardize on BOSTON Gear Precision Gears . . . for certified quality . . . for nearby supplies IN STOCK. Call your Distributor for New Catalog PG 160 and complete information. Boston Gear Works, 60 Hayward St., Quincy 71, Massachusetts.

Advt. copyright by Boston Gear Works



Get the **NEW**
PRECISION GEAR
Catalog PG 160

MEMBER OF

CALL YOUR NEARBY **BOSTON Gear DISTRIBUTOR**

— *STANDARDIZATION PAYS* —

956

different
motorized
speed reducers

available from stock

Yes! 956 different combinations of Perfection Motorized Worm Gear Speed Reducers are available for immediate delivery, *from stock.* Ratios range from 5 to 1 to 60 to 1, in capacities from 1/6 H.P. to 5 H.P. Perfection "C" Flange Reducers may be ordered complete with motor or without motor, to be used with a motor *of your own choice.*

Flanged motor reducers offer the maximum in compactness, rigidity and adaptability. Through the use of standard NEMA face mounted motors, complete interchangeability between motors is provided. Motor maintenance is possible without disturbing the drive and reducer. Motor assembly is fast and positive with no alignment problems.

Write for your free copy of our new 28 page catalog containing illustrations, charts and tables to help you choose the right Reducer for your particular application. Ask for Bulletin No. M-140.

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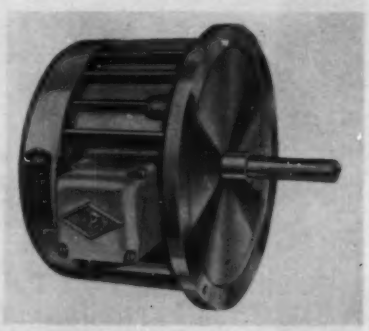
AMERICAN STOCK GEAR DIVISION
PERFECTION GEAR COMPANY, HARVEY, ILLINOIS



Machine Tool Motors Offered In 15 and 20-hp Ratings

1400 Series, built exclusively for machine tool use, feature a newly designed frame and are available in two new ratings in addition to the previous series of ½ through 10 hp.

Rotors are dynamically balanced and mounted between two heavy-duty ball bearings. Special radial air gap design with a light, thin, low-inertial rotor provides unusually smooth-start quick-stop operation. Extremely close tolerances are maintained throughout manufacture. Fin type, cast aluminum frames dissipate heat approximately three times as efficiently as cast iron. Units are available in TEFC and TENV types for continuous or intermittent duty.

Reuland Electric Co, Alhambra, Calif

MORE DATA? Circle 90, inside back cover

PROXIMITY SWITCH called Proxi-Tron, detects any type of metal without physical contact. This transistorized control is unaffected by temperature changes or normal voltage fluctuations. Applications include a machine tool limit switch; detection of metal inside non-metallic containers; metallic/non-metallic differentiation — *Automation Devices, Erie, Pa*

MORE DATA? Circle 91, inside back cover

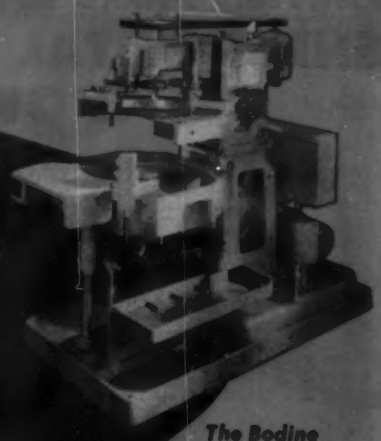
Bodine case history no. 50

whether you figure in

miles · millions · assemblies · tonnage

RUGGED Bodines

have set impressive records



The Bodine Basic Machine

for example:

142 miles

of drilled and tapped holes

The Paine Company is using a Bodine 42-30 to drill and tap anchor inserts (1018 free machining steel). This machine has been in service for 12 years averaging 1500 to 1700 pieces per hour; 1,500,000 per year . . . about 142 miles of drilled and tapped holes.

for example:

36 million

parts in 4 years

United Carr Fastener uses a 48-30 Bodine to tap 5/16-18 holes in 1020 steel dowels. For 4 years this machine has been running at 3600 pieces per hour . . . has produced over 36 million parts.

for example:

9 million

assemblies

Minneapolis-Honeywell uses a Bodine 42-30 for a combination of 10 operations on thermostat wall plates . . . cut off and insert 2 brass terminals — tap (5) #4-40 N.C. holes — insert 2 screws, check and eject. The machine has been running *continuously* for 4 years, completing an average of 35,000 pieces per week . . . close to 9,000,000 assemblies.

for example:

37 tons

of metal removed in 5 years

Elastic Stop Nut Corporation of America uses this Bodine 48-20 to drill, counterbore and tap 10-32 nuts. Five years continuous operation averaging 2500 pieces per hour has produced over 25,000,000 nuts . . . removed an estimated 37 tons of metal in the process.

NO MAJOR OVERHAUL . . .

The Bodine Basic Machines in these case histories have had NO MAJOR OVERHAULS. They are all running day in and day out right now. They are typical of the ENDURANCE, and LONG TROUBLE-FREE service every Bodine owner can expect in machines that are rugged, versatile and capable of multiple tooling and rapid changeover. Send us samples or prints for production analysis . . . without obligation. Write Dept. AM-10.

THE

Bodine

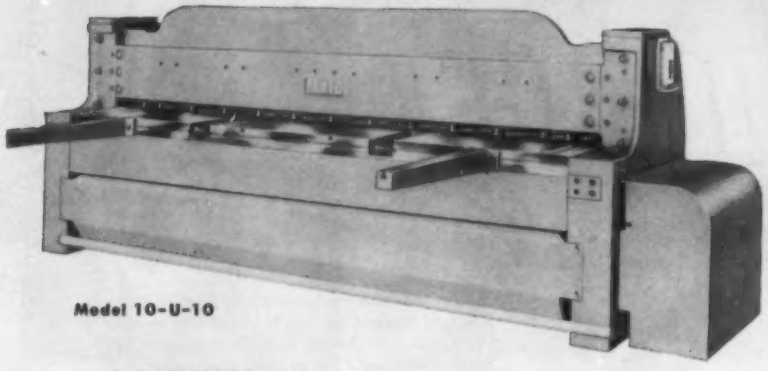
CORPORATION

BRIDGEPORT 5, CONNECTICUT

AUTOMATIC DIAL TYPE DRILLING, MILLING, TAPPING, AND SCREW INSERTING MACHINES

2BD59

FASTER, MORE EFFICIENT SHEET METAL POWER SHEARS — by PEXTO



Model 10-U-10

A COMPLETE LINE . . . . .

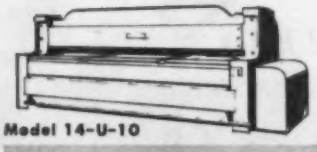
Outstanding in every detail these Precision Power Squaring Shears are engineered and built to shear sheet metal accurately and continuously at full rated capacity.

Frame, bed and crossheads are made from high grade machine tool castings. Positive, self-compensating holddowns; precision gauging and built-in blade clearances provide clean accurate cuts.

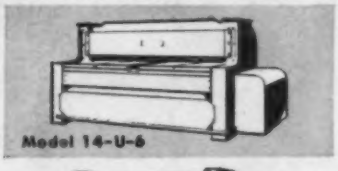
PEXTO Power Shears are designed for long-life maintenance-free operation. Six models efficiently and accurately handle any shearing problems from light gauge through 10 gauge sheet up to ten foot capacities.

SHEAR BLADE SERVICE

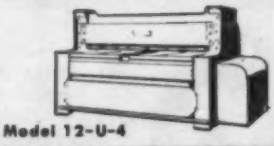
PEXTO four edge blades are precision-made from the finest domestic steel and will give maximum life and accuracy. When sharpening is required, fast factory service is available, enabling you to have new blade performance at all times.



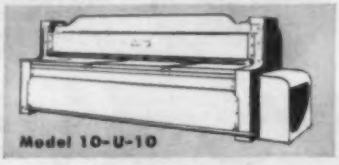
Model 14-U-10



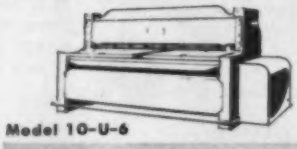
Model 14-U-6



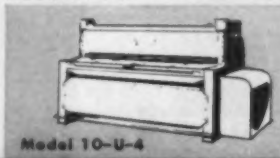
Model 12-U-4



Model 10-U-10



Model 10-U-6



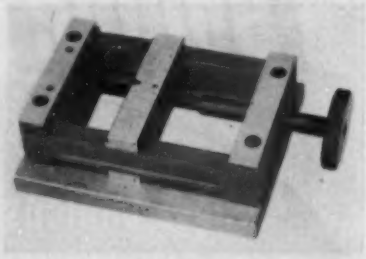
Model 10-U-4

Ask your Distributor or send for Bulletins 57 and 60.

THE PECK, STOW & WILCOX CO. Southington, Conn. U.S.A.

A complete line of machines and tools for Sheet Metal Fabrication

NEW SHOP EQUIPMENT



4½-in. Stepped-Jaw Vise Designed for Holding Small Work

Vise, added to line of accessories for use with the Linley jig boring machine, has stepped jaws, eliminating the need for parallels. Vertical V-groove in the sliding jaw securely holds round work.

All-steel unit, hardened and ground, has side rails and stepped jaw all parallel to the base within 0.0002 in. throughout their entire length. Capacity is 4½ x 4½ in. Meehanite base, for clamping purposes, measures ⅝ x 5¾ x 7¼ in. Threaded holes are provided in the fixed jaw for mounting of locating or positioning stops for production runs. High location of the screw concentrates the pressure in line with the clamping area, reducing any tendency of the sliding jaw to tip.

Linley Brothers Co, 682 State St, Bridgeport 1, Conn

MORE DATA? Circle 92, inside back cover

Half-Inch Dial Micrometer Designed for Fast Top Reading

This new quick-acting, easy-to-read, ½-in. dial micrometer is designed for repetitive measuring operations where the top-reading dial gives rapid, easy reading. It has a range of 0 to ½ in. and will measure in 2 in. from the edge of a flat plate.

Because it has a deep-throated frame and design, the micrometer can be used with one hand, leaving the other free to handle work being measured.

J T Slocomb Co, South Glastonbury, Conn

MORE DATA? Circle 93, inside back cover

GENERAL ELECTRIC

now!

Tri-Clad '55' motors with THERMO-TECTOR* system

WARRANTED

against burnout from overheating

For the *first time* General Electric offers you a motor with such *positive* protection it is WARRANTED in writing against overheating burnout!

G.E.'s exclusive new THERMO-TECTOR system gives Tri-Clad '55' motors truly *inherent* over-temperature protection. Unique variable shut-off feature allows motor to deliver *full power potential* under all operating conditions. Fail-safe THERMO-TECTOR system has simple, two-lead hookup.

*Trade-mark of General Electric Co.

For the first time General Electric offers you a motor with such *positive protection* it is WARRANTED against *overheating burnout*

TURN PAGE FOR FURTHER INFORMATION

NOW - A Motor *Warranted in Writing* Against Overload Burnout!

General Electric Company warrants to the Purchaser that the Tri-Clad '55' motor with Thermo-Tector system delivered hereunder will:

(a) **Not burn out because of overheating resulting from overload, lack of ventilation, single-phasing, stall, high ambient, or voltage unbalance, as long as the Thermo-Tector switches are connected into the control circuit so that power to the motor is removed when an over-temperature condition occurs;**

(b) **Be free from defects in material, workmanship and title; and**

(c) **Be of the kind and quality designated or described in the contract.**

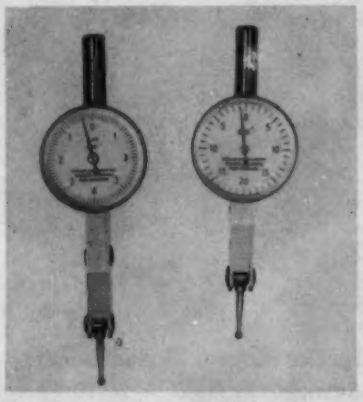
The foregoing warranty is exclusive and in lieu of all other warranties whether written, oral, or implied (including any warranty of merchantability or fitness for purpose). If it appears within one year from the date of shipment by General Electric Company that the equipment delivered hereunder does not meet the warranties specified above and the Purchaser notifies the General Electric Company promptly, the General Electric Company shall thereupon correct any defect, including non-conformance with the specifications, at its option, either by repairing any defective part or parts or by making available at the General Electric Company's plant, a repaired or replacement part.

The liability of the General Electric Company to the Purchaser (except as to title) arising out of the supplying of the said equipment, or its use, whether on warranty, contract or negligence, shall not in any case exceed the cost of correcting defects in the equipment as herein provided and upon the expiration of said one year, all such liability shall terminate. The foregoing shall constitute the sole remedy of the Purchaser and the sole liability of the General Electric Company.

General Electric's *exclusive* THERMO-TECTOR system is available now on *all* Tri-Clad® '55' motors in frames 254U-445U. Contact your General Electric Apparatus Sales Office or Authorized Distributor *today* for details on this NEW FULLY WARRANTED MOTOR PROTECTION SYSTEM. Or, write for Bulletin GEA-7092, Section 866-04, Schenectady 5, N. Y.

SMALL AC MOTOR & GENERATOR DEPARTMENT

GENERAL ELECTRIC



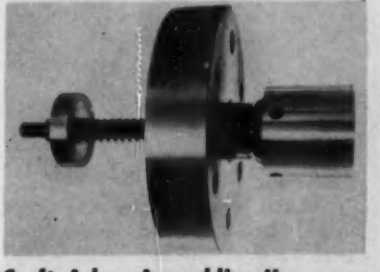
New Series of Test Indicators Introduced by Mueller

G301 and G303 indicators are available in 0.001 (subdivided in 0.0005 by a dot) and in 0.001 graduation; also available in millimeters. Movement is always clockwise when changing direction of pressure on the contact point. Latter will not slip, and operates in a 180° arc. The 1/32 contact points, available in carbide and hardened tool steel, are threaded for interchangeability.

Features include ball bearing; no reversing lever; geared mechanism; extreme sensitivity; measuring pressure less than 15 gr. Measuring range of 0.001 indicator is 0.040 in.; range of the 0.0001 is 0.008 in.

Mueller Laboratory, 1052-1058 N Allen Ave, Pasadena, Calif

MORE DATA? Circle 94, inside back cover



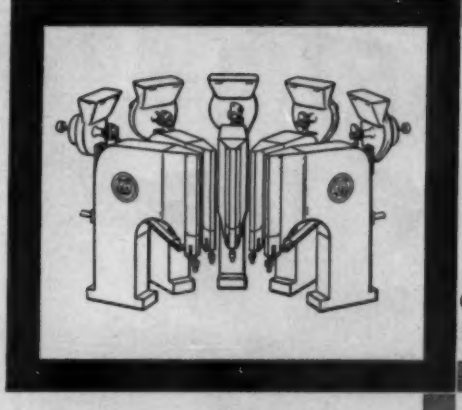
Craft Arbor Assemblies Have Replaceable Expanding Arbors

These expanding arbor assemblies, with replaceable arbors, are said to improve work holding for higher precision machining to closer tolerance requirements. The assembly consists of a face plate, arbor master, and expanding bar. Face plate is attached to the tapered spindle nose by six ⅝-in. dia bolts. Face plate taper is the American Standard taper of 7° and 7½ in.

Craft, Inc, 2457½ Chico St, El Monto, Calif

MORE DATA? Circle 95, inside back cover

NEW "BUILDING BLOCKS" ... for automatic riveting

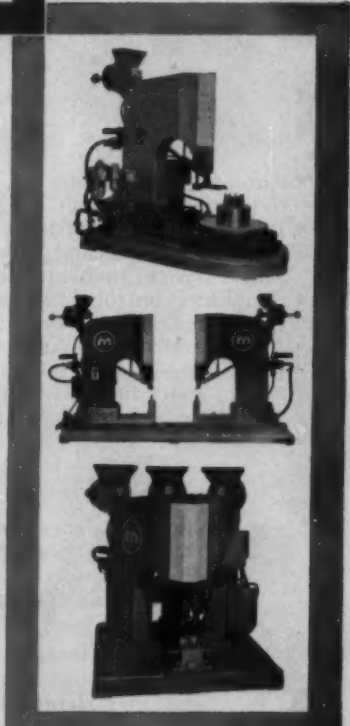


Milford's Models 56 and 57 offer unlimited flexibility in automatic assembly

The narrow wedge shape of Milford's new air-actuated riveters permits unusually close riveting. Both models can be combined with sliding-fixtures, indexing tables or similar attachments to give greatest flexibility of assembly. Air-operated toggle action assures fast and safe action. Model 56 handles tubular rivets from ⅛" diameter x ⅝" length; Model 57 from 3/16" diameter x 3/4" length.

Group these new "Building Blocks" to suit your own production needs. Use them singly, in pairs, in threes, fours or even fives. Multiple riveting is the newest answer to reducing production costs.

For more new ideas, tips and technical data on tubular rivets and rivet-setting machines, ask your Milford Representative for a look at Milford's new MANUAL OF MODERN RIVETING PRACTICE.



THE MILFORD RIVET

MILFORD RIVET & MACHINE CO.

MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
ELYRIA, OHIO • AURORA, ILLINOIS • NORWALK, CALIF.

◄ CIRCLE 268 READER SERVICE CARD

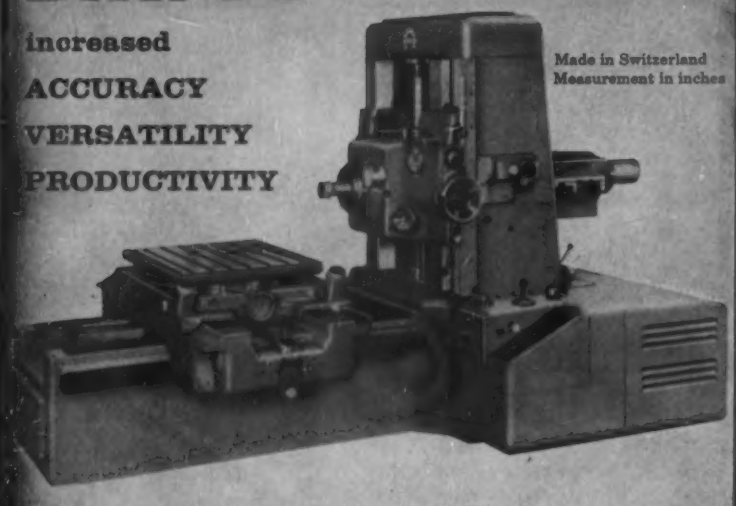
CIRCLE 269 READER SERVICE CARD

CUT ACCUMULATED ERRORS to a minimum

with the

DIXI 75 horizontal optical jig borer

increased
ACCURACY
VERSATILITY
PRODUCTIVITY



Made in Switzerland
Measurement in inches

- Automatic positioning can be changed instantly to manual operation
- Projected optical setting—direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference
- Simplified controls functionally arranged for greater operating speed and efficiency
- 3" diameter boring spindle
- Increased capacity: table size 39⅜" x 32"; 29⅝" cross travel; 23⅝" longitudinal travel; 25⅝" vertical travel
- Hydraulic feeds and infinitely variable spindle speeds
- Rear support optional

MBI has engineers available for consultation, guarantees service by factory trained staff, and stocks spare parts in New York.—Join the long list of leading aircraft and manufacturing plants throughout the United States which are using the horizontal optical jig borer.

Demonstrations upon request at our conveniently located demonstration centers.

MBI

M. B. I. EXPORT & IMPORT LTD.
A DIVISION OF MACHINERY BUILDERS, INC.
475 Grand Concourse, Bronx 51, N. Y.
Swiss Accuracy plus U. S. Know-how

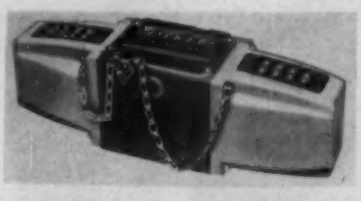
Special Purpose Thread Grinder Available in From ¼ to 10 hp

Unit, with spindle adjustment for various lead angles, is designed for engine lathe cross-slide mounting. It is furnished with matched Class 7 precision bearings and electronically balanced motor and spindle. It features a vertical feed adjustment for obtaining centerline alignment and can be supplied with a built-in wheel dresser with necessary adjustments for various wheel angles. Pulleys can be supplied for several sizes of wheels, either resinoid or vitrified.

Pictured is a 7½-hp grinder furnished for 18 x 1 x 2-in. wheels. Other models are available from ¼ hp for 4-in. wheels to 10 hp for 20-in.

US Electrical Tool Co, 3640 Llewellyn St, Cincinnati 23, Ohio

MORE DATA? Circle 96, inside back cover



8-gpm 4-Way Valve Incorporates Improved Air-Cooled Solenoids

Directional control valve with nominal rating of 8 gpm can handle flows up to 12 gpm without malfunction. Subplates are furnished with ⅜-in. ports or with ½-in. ports to take advantage of the larger flows. Maximum recommended operating pressure is 3000 psi.

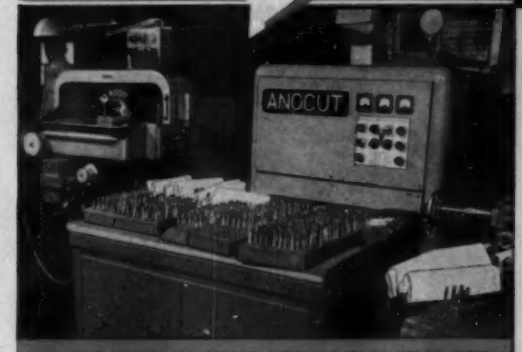
Air-cooled solenoids are retained in their cover rather than being mounted separately. In addition to quiet and cool operation, shock-free performance is said to be assured through superior cushioning. The solenoids are rated for 115-v 50 or 60-c ac service. Same valve is also available with oil-immersed sole-solenoids.

Vickers Inc, Detroit 32, Mich

MORE DATA? Circle 97, inside back cover

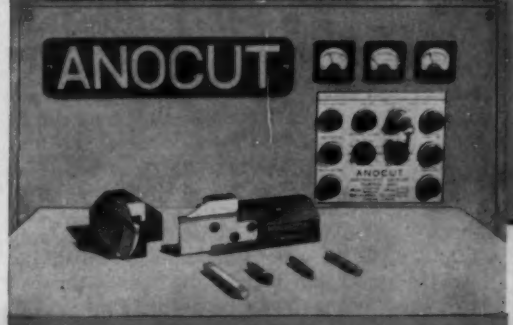
MANCHESTER MACHINE & TOOL CO. Reports...

CARBIDE TOOL PRICES held steady... Since 1954 WITH ANOCUT ELECTROLYTIC GRINDING



ANOCUT MODEL 300 POWER SUPPLY SHOWN BEING USED WITH HAMMOND CARBIDE TOOL GRINDER, GRINDING FRONT ANGLE ON MANCHESTER CARBIDE CUTOFF TOOL INSERTS. THE SAME COMBINATION IS ALSO USED TO GRIND THE SIDE CLEARANCES ON THE SAME TOOLS.

OPERATOR SHOWN GRINDING FRONT ANGLES ON MANCHESTER CARBIDE-TIPPED INSERTS WITH ANOCUT-HAMMOND ELECTROLYTIC GRINDER IS RAYMOND E. NOVKOV, JR.



THIS PHOTOGRAPH SHOWS MANCHESTER MACHINE & TOOL COMPANY FACE GROOVING HOLDER AND CUTOFF HOLDER, BOTH USING CARBIDE TIPPED INSERTS. IN THE FOREGROUND ARE SOME OF MANY STANDARD AND SPECIAL CARBIDE INSERTS, ALL OF WHICH ARE PROCESSED USING ANOCUT ELECTROLYTIC GRINDING EQUIPMENT.

MANCHESTER MACHINE & TOOL CO.
MANUFACTURERS OF THE
Manchester Cut-off & Grooving Tools
5142 MANCHESTER ROAD
AKRON 19, OHIO

May 25, 1960

Mr. C. R. Stroupe, Vice President
Anocut Engineering Company
631 West Washington Blvd.
Chicago 6, Illinois

Dear Mr. Stroupe:

We have been using our ANOCUT-HAMMOND SCE-6 Oscillating Grinder now for four years. During this period our production rate has steadily increased and our diamond and labor costs have steadily decreased. We constantly find new uses for this machine.

Our second machine, the CME-6, is our "Handy-Andy" for roughing off stock before precision grinding operations. The diamond savings using the CME-6 alone exceed the monthly cost of the machine.

You may well gather that we are satisfied ANOCUT users. We are also satisfied customers. The expert, prompt, and willing service provided by Tom Tomczak, your Cleveland representative, has been of real assistance in the operation of our business. The ANOCUT process and Anocut-Hammond machines have enabled us to hold our prices steady since 1954.

Very truly yours,

MANCHESTER MACHINE & TOOL CO.

Raymond E. Novkov

RAYMOND E. NOVKOV
President

aj

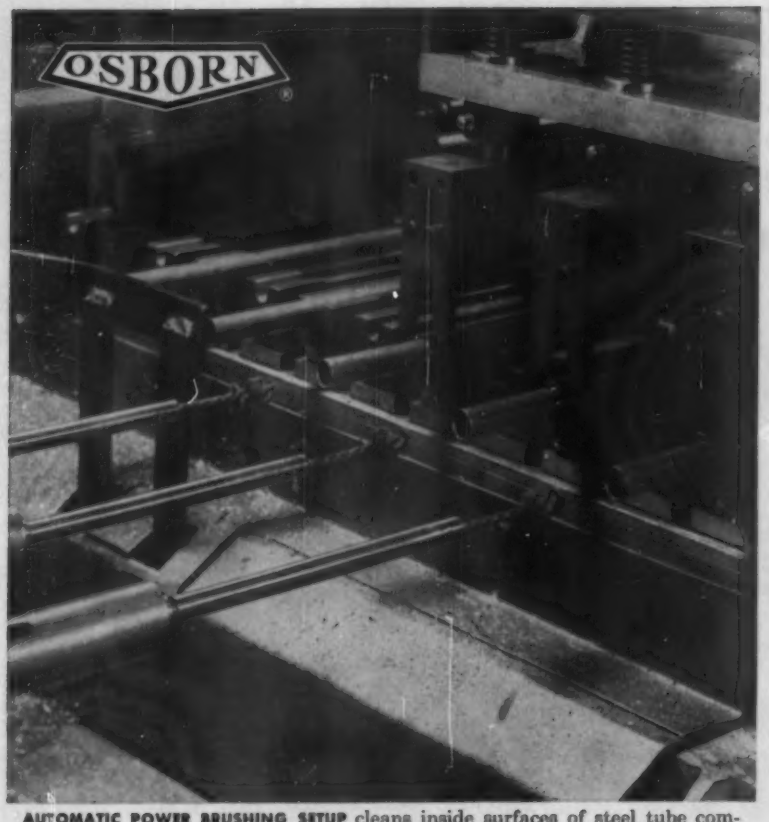
Read How...

MANCHESTER MACHINE & TOOL CO.
***INCREASED OUTPUT** of Cutoff and Grooving Inserts while **REDUCING PRODUCTION COSTS** with **ANOCUT**ting Equipment.*

ANOCUT

ENGINEERING COMPANY

631 WEST WASHINGTON BLVD. • CHICAGO 6, ILL.
PHONE STATE 2-5480



AUTOMATIC POWER BRUSHING SETUP cleans inside surfaces of steel tube components. Conveyor stops for every three tubes while three Osborn Helituf® brushes (operating at 380 rpm) advance through more than half the tube length. As they withdraw, three more brushes enter from the opposite end to complete the operation. Tube interiors are power brushed clean . . . all burrs removed. Rate: 750 pieces per hour.

FAST CLEAN-OUT for tubing

. . . 12,000 a day with OSBORN power brushing

Needed: a fast, low-cost way to clean the inside surfaces of these steel tube components. This auto equipment maker picked Osborn power brushing to do the job.

Here's How: Mounted on a special six-spindle machine, Osborn Helituf® brushes give the tubes a quick, thorough clean-out. Tubes are cleaned three at a time, with total production at 12,000 pieces per day on two 8-hour shifts. Hidden dirt, burrs and weld slag are completely removed from the hard-to-reach inside surfaces. The operation is fully automatic, effective, economical.

Tough metal finishing jobs of *every* description—deburring, cleaning, polishing, precision blending—can be simplified with advanced Osborn power brushes and brushing methods. An **O**sborn **B**rushing **A**nalysis—made in your plant now at no obligation—can show you how to increase production, improve quality and trim your costs. Write or call *The Osborn Manufacturing Company, Dept. C-104, Cleveland 14, Ohio. Phone ENdicott 1-1900.*

Osborn Brushes

Metal Finishing Machines . . . and Finishing Methods
Power, Paint and Maintenance Brushes • Foundry Production Machinery

Surfindicator Adapter Measures Surface Roughness of Holes.

Model BL-132, an adapter for the Surfindicator (a precision instrument for measuring surface finish), is designed to measure the surface roughness of the bottoms of holes, slots, counterbores, and any area below the surface level. It is used as an accessory to the Brush General Purpose Pickup Model BL-110.

The adapter may be used either for hand-held or for motor-driven operation to measure roughness in the range from zero to 250 micro-in. It measures the surface in bottoms of holes as small as ⅜ in. ID to a maximum depth of 1 in. Removal of the motor drive tang from the adapter permits measurement of bottoms of holes with an ID of 3 in. to a maximum depth of 2 in.

Brush Instruments, 37th & Perkins, Cleveland 14, Ohio

MORE DATA? Circle 98, inside back cover

2-Pad Vacuum Attachment Lifts Up to 1 Ton

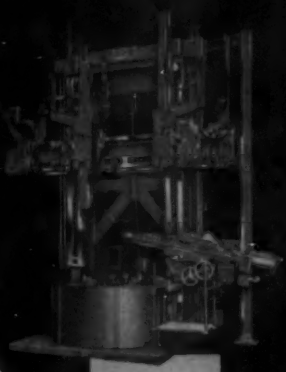
All-purpose "below the hook" hoist or crane Vac-U-Lifter enables one operator to lift a single piece of material in either a horizontal or vertical position (locked), or tilt material in any position within a 90° arc. It will handle metals, glass, structurals, plastics, and wood.

Unit is entirely self-contained, of welded steel construction, and only 6 in. wide from the bottom of the vacuum pad to the top of the pad beam. Narrow width allows it to fit between vertical stacks of plate steel. Price is below $1000 for most models.

Vac-U-Lift Co, Div of Siegler Corp, Salem, Ill

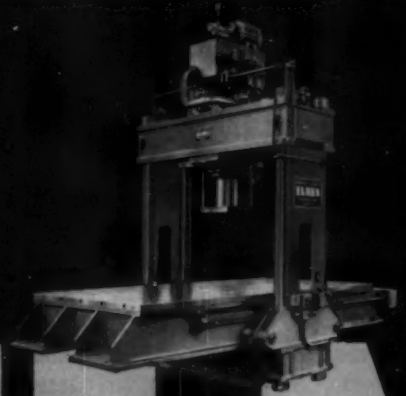
MORE DATA? Circle 99, inside back cover

CUSTOM Designs...
in addition to complete
STANDARD lines...



Special 72" KING with extended height under rail, tracer controlled turning and grinding, angular mounted side head rams, and console controls.

KING



Specially designed ELMES 400-ton Traveling Head Straightening Press handles a wide variety of sizes and shapes of castings for builder of heavy construction machinery.

ELMES

KING *Vertical Boring and Turning Machines*
ELMES *Hydraulic Presses and Equipment*

American Steel Foundries **ELMES/KING DIVISION,** Cincinnati 29, Ohio

meet one of the few things CIRCO *ultrasonics* can't clean!

Grimy gamins, we admit, are one of the few things that Circo ultrasonic units can't clean. And we gladly relegate such problems in dirt to patient mothers.

But there's very little else that Circosonics® can't clean — and clean **absolutely!**

From gears to glass, from clocks to printed circuits, from housings to hypodermics, from meters to missiles — that's only a little of the high, wide and handsome range of proven applications for Circo ultrasonics.

Fact is, wherever absolute product cleanliness is a must, or where cleanliness has created a production problem — there's a need for Circosonics®.

These amazing units actually blast dirt loose, yet never harm your product — and they do the job **in mere minutes or less!**

Circo, long a leader in degreasers, washers and cleaning machinery of all types, pioneered the field of ultrasonic cleaning and is the only manufacturer delivering 2500 watt and higher units today. So, of course, the application and acceptance of Circo precision-built equipment is as vast as it is varied. And the list grows longer each day.

Chances are there's an application for Circo ultrasonics in your business. Whether you need a bench model or a huge custom-designed conveyorized system, Circo engineers can recommend the specific Circosonic® unit to solve your problem. Circo, you see, offers the widest line of ultrasonic units to be found anywhere.

You'll clean-up with Circo in every way: in precision cleaning, in economy, in speed, and in the finest quality.

Here's more specific information

CIRCO CORPORATION • CLARK, NEW JERSEY

CIRCLE 274 READER SERVICE CARD

WHAT'S YOUR LINE?

whatever you make—

Circosonics®

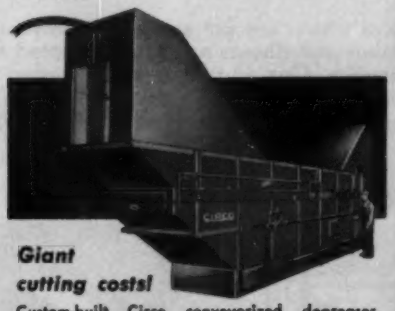
can solve your

cleaning problems

Name it — and a Circo ultrasonic unit can do the cleaning job! Swiftly, safely they remove solder flux, fingerprints, polishing compounds, rust or oxides, lubricants, salts and many other contaminants. What's more, Circosonic® cleaning reduces solution consumption and eliminates costly hand operations.

Mighty meter cleaner!

This Circo ultrasonic Model BC 125 quickly, absolutely cleans delicate meter parts requiring cleanliness to tens of microns. Result? Savings in disassembly and hand labor are dramatically achieved!



Giant cutting costs!

Custom-built Circo conveyorized degreaser chalks-up big savings for Purolator Products Inc., Wayne, Mich. Linked-up with the production line, this giant degreaser super-cleans filter parts and speeds them on their way in record time, at lowest per unit cost. This unit is simple to operate, easy to maintain, and operates on a continuous production line basis.

- ***Put Circo's 37 years of experience in planning, engineering and installing cleaning equipment to work for you. Call your nearest Circo office for information and advice. Representation in all major cities.***

Clean up with **CIRCO**

CIRCO CORPORATION

ULTRASONICS • WASHERS • DEGREASERS
Solvents

51 Terminal Ave., Clark, New Jersey

Bren Weld Offers New Portable Blast Cleaner

Model BC-1 portable blast cleaner features an exclusive blasting gun which provides trigger operated control. In addition, the continuous feeding of abrasive during the blasting operation provides efficient, economic, and speedy results.

Weighing 25 lb, 20-in. high, and having a capacity of 50 lb sand, the BC-1 comes with hood, blasting gun, adjustable feed elbows, screen, and 10 ft of blast hose and connection.

Bren Weld Corp, 5114 Third Ave, Brooklyn 20, N Y

MORE DATA? Circle 100, inside back cover

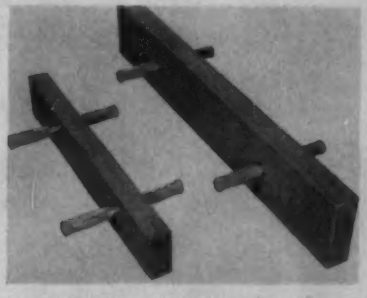
4-in. Direct Reading Gage Is Subdivided to 0.000025 In.

A new vertical gage with a direct measuring range between 0 and 4 in. from a master glass scale which is optically subdivided into 0.000025 in. can be increased to the measuring range of 8 in. by resetting to a 4-in. gage block. The range of the super-precision scale in either case is 4 in., in steps of 0.050 in.

All readings are on projection screens and so organized that they are absolutely fool-proof. A large assortment of interchangeable anvils and contact tips is available as standard equipment.

Opto-Metric Tools, Inc, 137 Varick St, New York 13, N Y

MORE DATA? Circle 101, inside back cover



Precision Granite Straight Edges Available From 2 to 6 ft Long

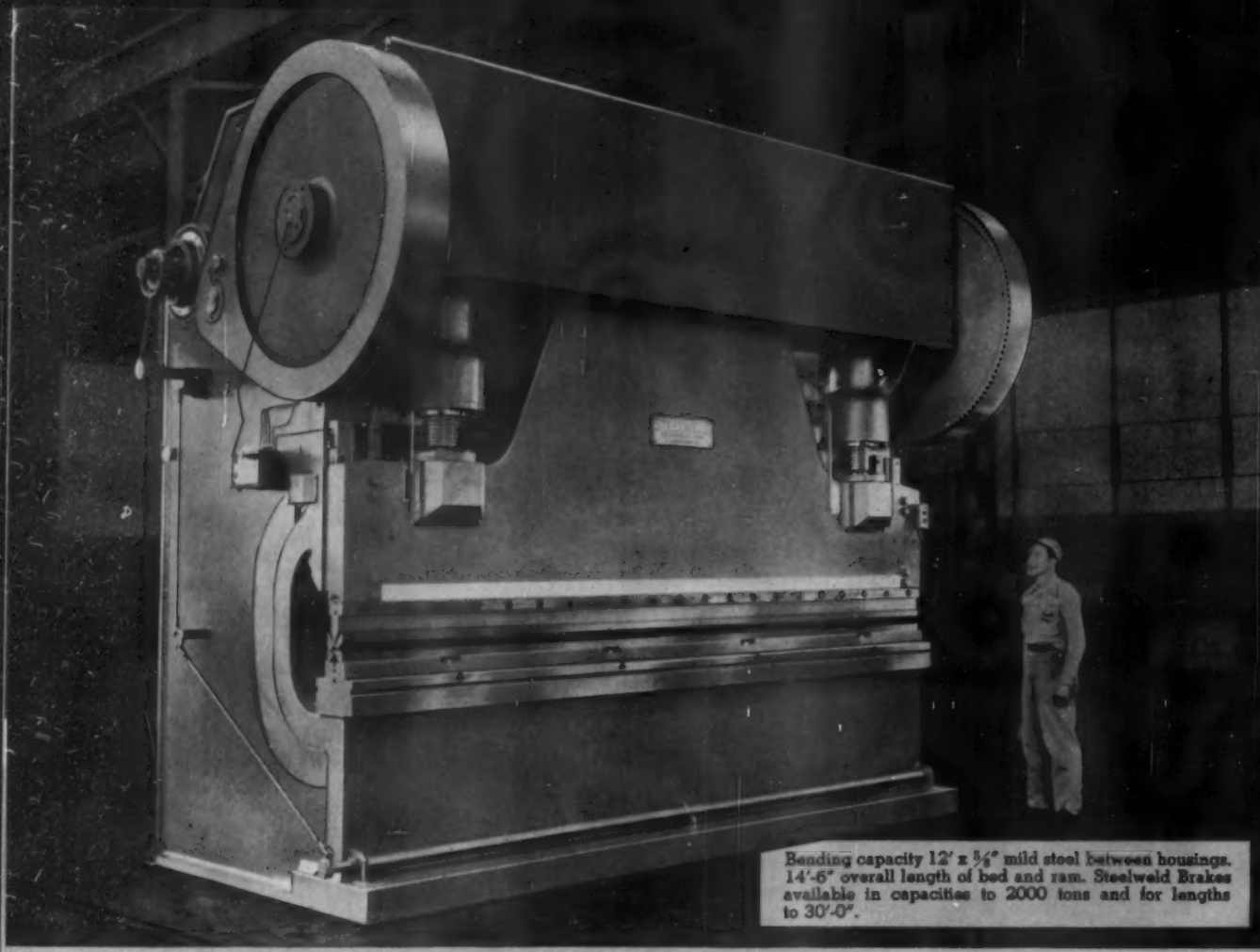
Straight edges, for checking the accuracy of large flat surfaces, are made with one edge precision finished. Versatile rectangular design permits the second edge also to be precision finished if desired. This converts the straight edge into a parallel with handles for ease of operation. These metal handles, insulated with plastic grips, can be removed for storage. When the straight edges are converted into parallels, they can be furnished in matched pairs if required. They are manufactured of both Mt Airy gray quartz granite and Balfour pink quartz granite.

Herman Stone Co, 1860 N Gettysburg Ave, Dayton 27, Ohio

MORE DATA? Circle 102, inside back cover

CARTRIDGE RELIEF VALVE, a low-pressure, chatter-free, direct-operating unit, has a 10 to 500 psi operating range. When installed in a single body or a multi-valve manifold, it simplifies circuitry and can be easily removed for sevicing without disconnecting lines *—Fluid Regulators Corp, 313 Gillette St, Painsesville, Ohio*

MORE DATA? Circle 103, inside back cover



Bending capacity 12' x ⅝" mild steel between housings. 14'-6" overall length of bed and ram. Steelweld Brakes available in capacities to 2000 tons and for lengths to 30'-0".

BRAKES and SHEARS BUILT

STEELWELD machines are built to withstand the rigors of mass-production high-speed work, as well as meet the needs of jobbing shops requiring frequent set-up changes. They are liberally designed throughout to assure maximum service with minimum maintenance. A wide array of desirable features are provided, some of which are not available elsewhere.

Steelweld Brakes and Shears are easily adapted for special requirements. Our engineers will be glad to work out design changes to speed production, improve safety or bring about other advantages for specific applications.

A Few of the Outstanding Press Brake Features

SW-309

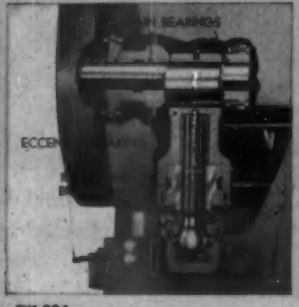
Long Life Clutch and Brake

Heavy construction assures long trouble-free life. Facings are extra heavy and plates solid. Cool air constantly flows across plates. Adjustments easily made without tools.

SW-458

Slides Compensate For Wear Automatically

V-shaped slides and guides eliminate loose gibbing. Take up wear automatically. Easily removed and replaced.



SW-304

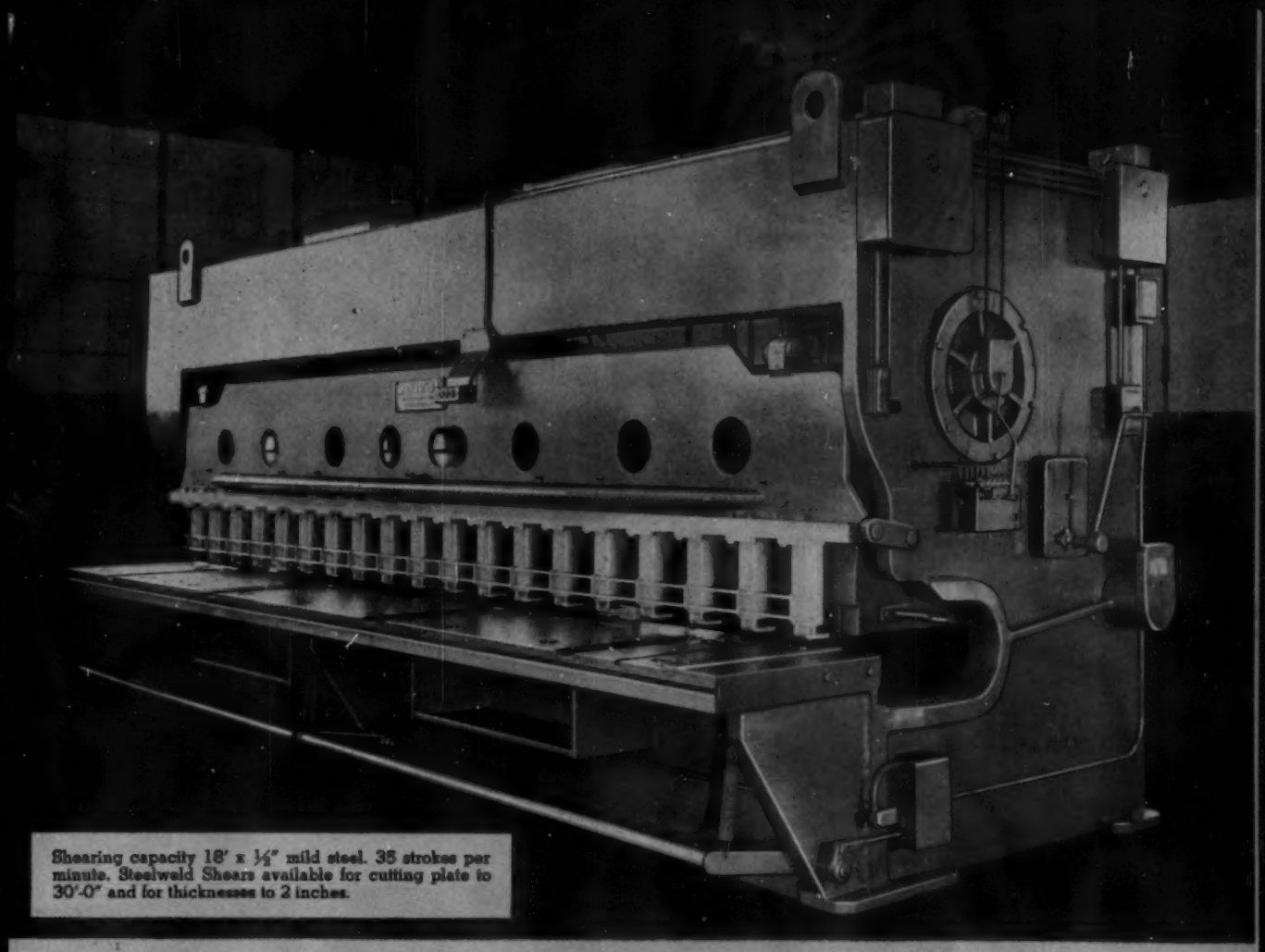
Six Large Main Bearings

Each of the two eccentric shafts which drive the ram has three heavy bronze bearings. Ram adjustment is made by revolving nut. Screws do not turn; therefor, ball joint wear is reduced.

SW-441

Extra Deep Throat

18-inch throat is standard on all Steelweld Brakes. This permits making bends to 18 inches from edge of plate for full length of dies.



Shearing capacity 18' x ½" mild steel. 35 strokes per minute. Steelweld Shears available for cutting plate to 30'-0" and for thicknesses to 2 inches.

FOR **HEAVY DUTY** SERVICE

Many Important Shear Advantages

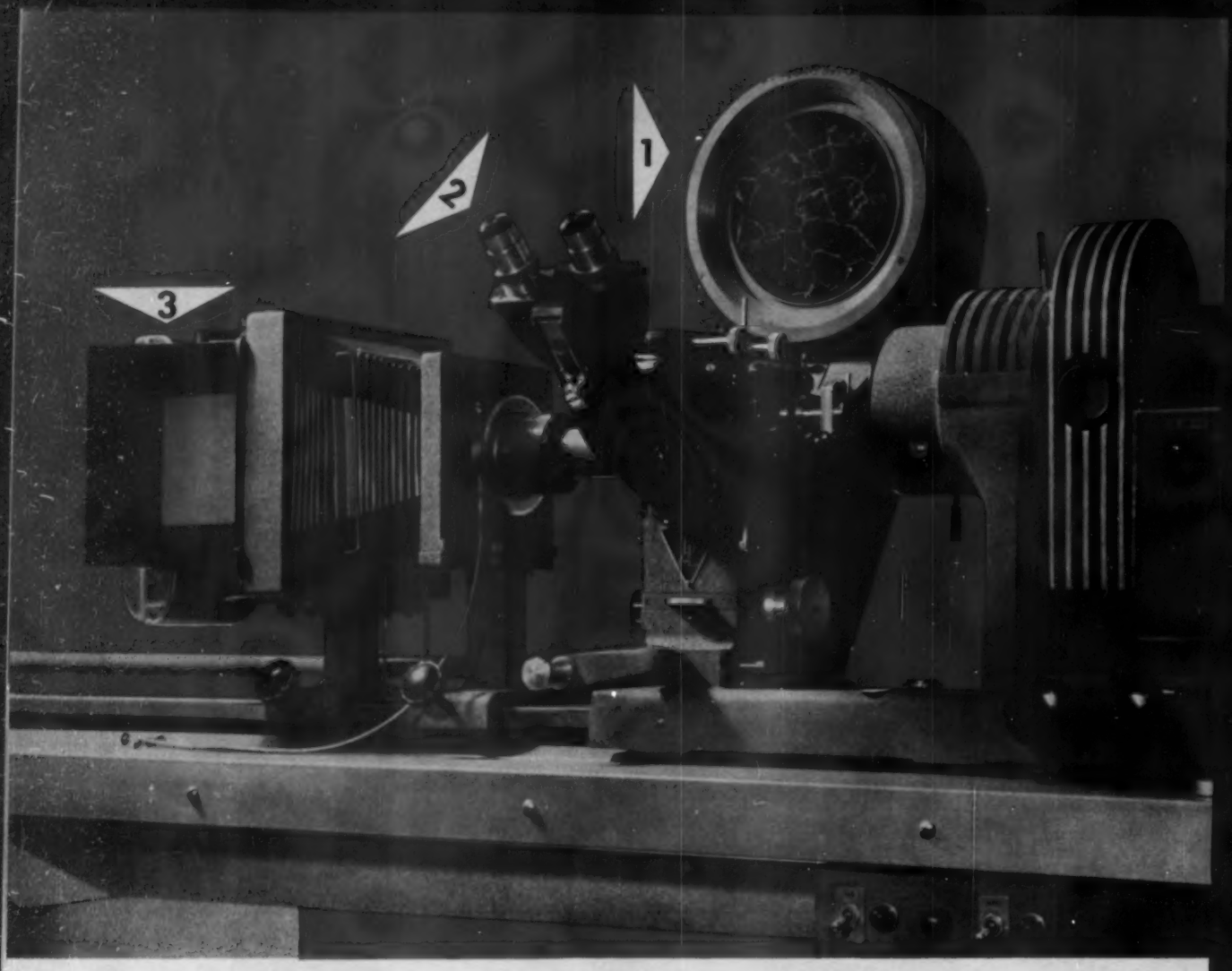
1. Pivoted blade operation.
2. No slides or guides to wear.
3. Knife clearance easily adjusted to suit plate thickness.
4. Smooth, sharp accurate cuts.
5. Low rake.
6. Negligible twist, camber and bow in cut pieces.
7. Fast cutting and high production.
8. Easy and simple to operate.
9. Convenient electric foot control.
10. Trouble-free mechanical hold-downs.
11. Easily arranged for squaring, slitting and notching.
12. Convenient, accurate, ball-bearing mounted back gauge.
13. Quiet operating.
14. Designed for safety throughout.
15. Long knife wear between grindings.
16. Knives easily removed and replaced.
17. All-welded one-piece frame with bed integral.

GET THESE BOOKS!

Catalogs No. 2010 (Brakes) and No. 2011 (Shears) give construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.
1457 East 282nd Street, Wickliffe, Ohio

STEELWELD
BRAKES and SHEARS



GEAR STEEL has no secrets here

This instrument provides three ways to examine the micro structure of steel.

1. *View it on the screen.*
2. *Examine it through a microscope.*
3. *Then take its photo for a permanent record.*

Thus, chemical constituents can be analyzed, hardness patterns detected, and precise control of heat treatment can be determined.

This is one of many details of gear manufacture and inspection that have won Double Diamond gears their reputation as gears thoroughly qualified for high level performance in any application for which you buy them.

Our representatives are gear specialists and designers. May they "talk shop" with you now, or whenever you want to learn more about the right gears for your product?

Just write or phone.

EATON

AUTOMOTIVE GEAR DIVISION
MANUFACTURING COMPANY
RICHMOND, INDIANA

GEARS FOR AUTOMOTIVE, FARM EQUIPMENT AND GENERAL INDUSTRIAL APPLICATIONS
GEAR-MAKERS TO LEADING MANUFACTURERS

Star Cutter Purchases Baker Keyseater Line

Star Cutter Co of Farmington, Mich, has bought the line of keyseaters, profile grinders, and keyseater cutters manufactured by Baker Brothers, Toledo, Ohio. Purchase includes all stocks, machines-in-process, and all patterns, jigs, fixtures, and special tooling for producing the machine tools.

Acquisition was made in accordance with company plans to expand its activities in the machine tool field. In addition to production of cutting tools, Star has had extensive experience in the designing and building of machine tools. They've rebuilt hundreds of hob sharpeners and rotary surface grinders into automatic feed types incorporating proprietary machine design developments.

Rocketdyne Gets $44 Million Order For Rocket Engine Development

National Aeronautics and Space Administration has completed contract negotiations with Rocketdyne, a division of North American Aviation, to develop a 200,000-lb thrust rocket engine. NASA selected Rocketdyne's proposal to develop the engine last June over proposals from four other firms. Contract provides for a 4½-year development and qualification program to advance the hydrogen-fueled engine to proven flight capability.

The new engine, designated J-2, may be used in clusters of two or four to power the second and third stages of advanced versions of the Saturn space vehicle.

AF Contract to Beryllium Corp

Air Force has awarded a research and development contract to Beryllium Corp, Reading, Pa, for rolled beryllium structural shapes. Sponsorship of this new program by the AF is aimed at developing or improving techniques for mill rolling and hot extruding of beryllium raw materials more directly into structural components. In doing this, the beryllium industry's capabilities will be broadened to economically form a mill roll quality shape leading to substantial cost reduction on end parts required for aircraft, missile, and spacecraft construction.

Several other firms will work with Beryllium as subcontractors on certain phases of the program. Companies named were Allegheny-Ludlum Steel Corp of Pittsburgh, Budd Co of Philadelphia, and Nuclear Metals Inc of Boston.

Planer-mill, reported to be the largest in the West, is in operation at the Westinghouse Sunnyvale (Calif) manufacturing division. Here, low-pressure cylinder bases are being machined for a 100,000-kw steam turbine being built at the plant. The mill is 145 ft long, 24 ft high to top of its vertical columns, and required 18 freight cars to haul it from Rockford, Ill, where it was built by Ingersoll

Allis-Chalmers Buys Interest In French Tractor Works

Controlling interest in Etablissements de Constructions Mecaniques de Vendeuvre S A has been purchased by Allis-Chalmers, Milwaukee. Headquarters of the manufacturer of air-cooled diesel farm tractors, industrial engines, and engine-generator sets are in Paris, with manufacturing facilities in Dieppe

McGIRK'S WORKS

by GEO CRENSHAW

NOW THAT MR. McGIRK HAS WORKED HIS WAY UP TO THE TOP, I THINK HE KIND OF MISSES RUBBING ELBOWS WITH THE GANG!
YEA, I KNOW... HE'D STILL LIKE TO BE ONE OF THE FELLOWS...
... BUT ONCE A MAN GETS USED TO A LIMOUSINE AND CHAUFFEUR...
...THERE'S JUST NO CHANGING.
MOE'S CORNER

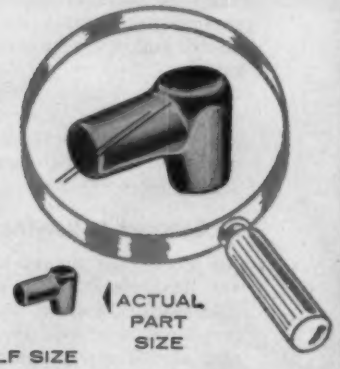
MUELLER BRASS CO. PRODUCES

SPECIFICATIONS . . . *REGARDLESS OF*

To obtain the desired physical and design requirements in a part at the lowest cost, there is usually one specific process by which that part can be most successfully and economically manufactured. Because the Mueller Brass Co. offers a variety of production methods, you get sound engineering, accurate production method analysis, our assurance of getting the best product at the lowest cost . . . regardless of metal specified or the size of your particular part.

BRASS, BRONZE, ALUMINUM FORGINGS

The two parts shown here dramatically illustrate the ability of the Mueller Brass Co. to produce precision forgings regardless of size or configuration. Both the tiny dental drill nozzle and the big heat exchanger shell hub, which is the largest of its kind ever produced, were forged to exacting specifications. The weight of the nozzle is only a few ounces while the shell hub weighs 40 lbs., and has a forged pocket 7 1/16" in diameter and 4 3/16" deep. By way of size comparison, the pocket is big enough to hold over 14,000 of these tiny drill nozzles. By forging the pocket, considerable machining time and money was saved. The sound, dense structure of the shell hub makes it ideal for the high pressure application for which it was designed. The forging not only does the job better, but was produced for 25% less than the casting it replaced. Experience makes it possible for the Mueller Brass Co. to produce high quality precision forgings regardless of specifications . . . why not put this experience to work for you?



Write today for Engineering Bulletins on any of these Products.

SCREW MACHINE PRODUCTS

POWDERED METAL PARTS

ONE DEPENDABLE

MUELLER BRASS CO.

MUELLER BRASS CO.

PARTS ECONOMICALLY...TO EXACT

METAL, METHOD OR SIZE...

When you are designing, specifying or purchasing fabricated parts, call in the "Man From Mueller Brass Co." to help lower costs and improve your products. Sales and engineering service is available to you at Mueller Brass Co. offices throughout the United States. Make Mueller Brass Co. your one dependable source for all your part needs.

COLD PREST® IMPACT EXTRUSIONS

Today, because of vast experience in alloys, the Mueller Brass Co. has greatly expanded the possibilities of parts production by the impact extrusion method. Aluminum, of course, has been successfully used for a multitude of tubular shapes. But now it is also possible to impact parts of copper alloys incorporating such major advantages as: closer tolerances, better finish and appreciable metal savings. Because of dimensional accuracy possible with the impact extrusion, the necessity of secondary machining operations is often eliminated.

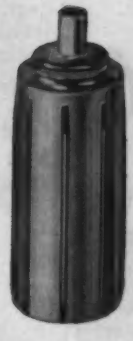
The parts shown here are representative of the group now being economically produced as impact extrusions by the Mueller Brass Co. who offer complete engineering and design service in the development of new parts from copper base alloys.

90-10 Copper Nickel Alloy

Aluminum Alloy 6061

Oxygen Free High Conductivity Copper

Special Alloy 902



Tellurium Copper Alloy

Low Phosphorus Copper Alloy

SOURCE FOR ALL THESE OTHER PRODUCTS

FORMED COPPER TUBE

STANDARD and SPECIAL ALLOY ROD

PORT HURON 24, MICHIGAN

819

Precision Operation In A Compact Design . . . Cuts Costs

LINLEY

JIG BORERS

Designed specifically for tool, model and experimental departments.

The Linley Jig Borer is accurate to a high degree. It is fast to set up and position and has the versatility required for precision tool room and die work, yet is low in cost.

Many time-saving accessories are now available for use with the improved Linley that add to its usefulness and simplify its operation.

Check on the many advantages of this improved jig borer. Table size is 7" x 17½"; table travel, 6½" x 10".

Send for descriptive literature.

LINLEY BROTHERS CO.
664 State Street Ext.
Bridgeport 1, Conn.

and in Vendeuvre. Established in 1837, the company, which now employs approximately 1000, is one of the oldest manufacturers of farm equipment in France.

The French company's own sales organization will distribute its products in France. Allis-Chalmers International, the sales organization for all A-C products outside the US and Canada, will handle distribution in other world markets.

American Technology Corp Buys into Pendar Inc

Pendar Inc, Van Nuys, Calif, designer and manufacturer of illuminated pushbutton panel and console switchlight combinations, has sold a substantial interest in the company to American Technology Corp. Sale was made to augment working capital and to provide additional management direction, according to C E Fisher, Pendar president.

$68 Million Navy Contract Goes to Chance Vought

Aeronautics Division of Chance Vought, Dallas, has received an order for continued production of the F8U-2N all-weather interceptor, a fighter capable of speeds twice that of sound. Contract provides for continued production of the carrier-based fighter through December 1962. This order brings to $162.6 million the total amount for the F8U-2N.

Fenn Buys Rights to Make New Deburring Machine

Fenn Manufacturing Co, Newington, Conn, maker of metal forming ma-

"I thought I'd fool around with it until you got here."

the special meaning

of BAIRD

54VC AUTOMATIC VERTICAL CONTINUOUS LATHE

Here at Baird we build Automatic Multiple Spindle Chuckers, Transfer Presses, Vertical Lathes, Bench Power Presses, and Four-Slide machines. Just for the moment, let's sidestep the usual claims of quality, accuracy, precision, and performance. Let's look at the men in both large and small companies all over the country who are entrusted with the responsibility of deciding what automatic machinery to buy . . . whose to buy . . . and when to buy them.

Baird has a special meaning to these people for a very simple reason. They have come to rely, not only on the products of Baird, but on the Baird way of working with them. When their machines arrive, they are in top operating order, ready for production. No waiting for them to be "finished on the floor".

76H CHUCKER

When you are looking for an experienced and valid opinion on manufacturing a high production part . . . if you need firm, factual information in a hurry to prove your point . . . when you require a sound, sensible quotation to justify your requisition . . . you can count on Baird. And afterward, too . . . you will find the willingness to assist in installation and initial operation positively refreshing.

Why not give us a chance to prove our point? Send us your prints or sample parts, plus specifications. We'd like to hear from you.

Frank Holmes

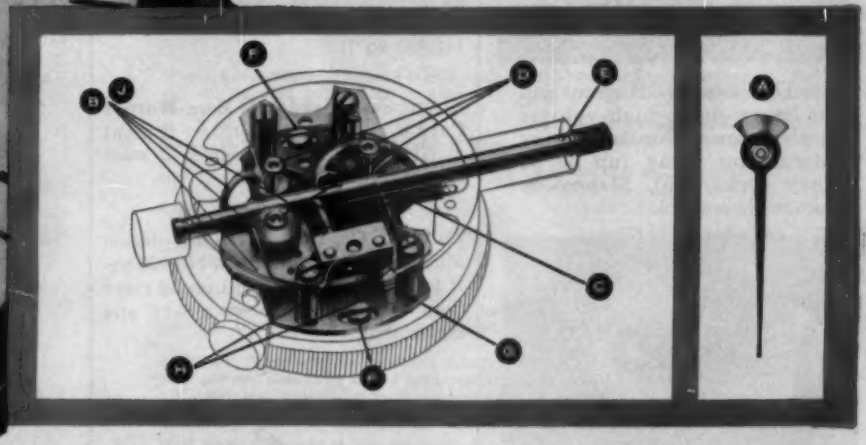
Frank C. Holmes

BAIRD

THE BAIRD MACHINE COMPANY
Stratford Avenue, Stratford, Conn.

You get all these *Plus Features* only in Federal Indicators

Full Jeweled Bearings, Unit Construction, Low Inertia Indicating Hand, Miracle Movement — each of these advancements pioneered by Federal has a particular significance to you in terms of better performance. AND, with all these *plus* features, Federal Dial Indicators generally sell for LESS due to their wide acceptance which has made possible the economies of quantity production. Here are the features and reasons why they are important:



A **Functionally designed Indicating Hand** balanced for low inertia, provides greater sensitivity and better repeat accuracy. Hand has highest strength-to-mass ratio to preserve position and shape under heavy gaging action.

B **Precision-made, Stainless Steel Gears, Rack and Pinion,** for a rustproof, smoother running, more accurate movement.

C **Positive Contact** with minimum pressure for faithful indicator response.

D **Full Jeweled Bearings** reduce friction, for improved accuracy over a longer period of time.

E **Precision Fit** of spindle and bearing for better repeat accuracy.

F **Accurate Movement Positioning** for optimum rack and gear alignment. Provides extremely close and positive control over a critical fit in *every* indicator.

G **Unit Construction** for easy maintenance and adjustment.

H **Rigid Assembly** of top and bottom plates for accurate gear alignment essential to minimum wear.

J **Gear and Rack Teeth** are hobbed with micro precision so that each Federal Indicator provides uniformly high accuracy throughout its *full* range.

MIRACLE MOVEMENT

For complete story on Miracle Movement, write . . .

FEDERAL PRODUCTS CORPORATION • 61210 Eddy Street • Providence 1, R. I.

Ask **FEDERAL** *First*

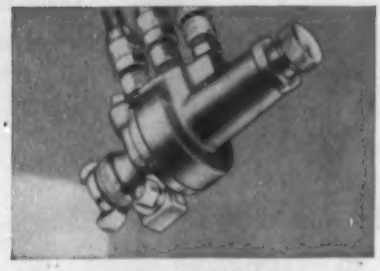
for recommendations in modern gages . . .

CIRCLE 283 READER SERVICE CARD

Dial Indicating • Air • Electric, or Electronic — for Inspecting, measuring, sorting, or automation Gaging

Increase the life of forming and cutting tools with spray cooling

Another benefit of DeVilbiss total service



Use DeVilbiss WDB spray gun for heavy-duty, high-volume applications. Continuous or intermittent spray (up to 60 spray cycles/min). Manual or automatic control.

DeVilbiss Multi-Mister is designed for jobs requiring continuous or intermittent fine spray mist. Complete with one- or five-gallon tank, one to four spray nozzles.

• • •

Write for complete data to: The DeVilbiss Company, Toledo 1, Ohio.

FOR TOTAL SERVICE, CALL
DEVILBISS

CIRCLE 284 READER SERVICE CARD

chinery, has purchased the Liquid Wheel Machine Co of Indianapolis and, with it, sole rights to manufacture a patented machine for deburring metal parts. So far only a prototype has been built; prior to actual production and marketing, the machine will be redesigned to Fenn standards and several basic improvements will be incorporated.

Process involves holding metal parts in a fixture and moving abrasive material past the piece. The automotive industry is reported to be more than a little interested in the machine, according to Fenn.

Action in Mississippi

Modern Tool & Die Co, Cleveland manufacturer of lawnmowers, wheelbarrows, and bicycles, will hire 250 workers for a new plant which will go into operation soon at Indianola. Facility will contain approximately 145,000 sq ft.

Atkins Saw Division of Borg Warner Corp is building a 292,000 sq-ft plant at Greenville. Production will start this month.

Flintkote Co, New York, has chosen Magnolia as the site for a 115,000 sq-ft facility. Company will spend more than $1 million for machinery and equipment.

"Why should I use logic when I can win the argument without it?"

Hardened, Tempered and Ground-from-the-Solid!

It pays to specify

ACE

DRILLS
REAMERS
BLANKS

Premium Quality High Speed Steel, Solid Carbide and Carbide Tipped.

ACE DRILL SETS

Standard stock sets include Fractional, Wire and Letter size drills, packaged in convenient folding index cases.

ACE BLANK SETS

Uniformly hardened high speed steel reamer and drill blanks precision ground to new close tolerance limits available in standard Fractional, Wire and Letter series sets.

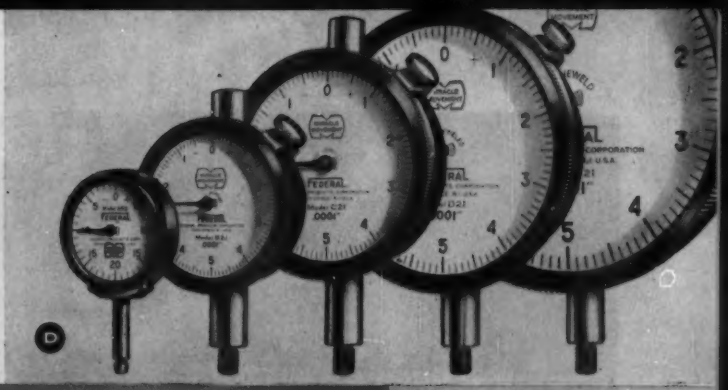
Call your local distributor today—or write Ace direct for latest catalog and price information.

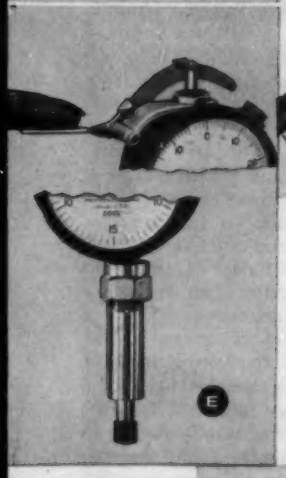
ACE DRILL
Adrian, Michigan

ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

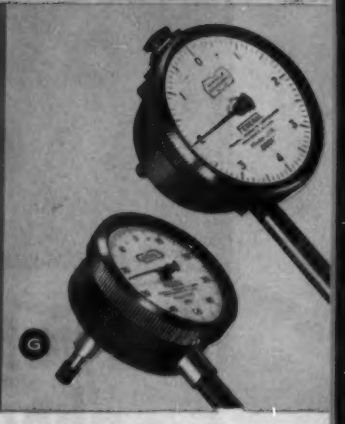
CIRCLE 285 READER SERVICE CARD

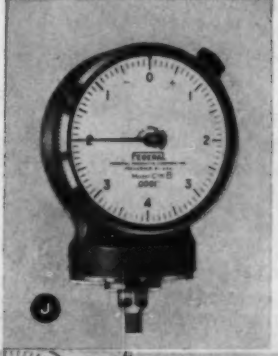
CIRCLE 286 READER SERVICE CARD ►





whatever you need in DIAL INDICATORS





A **Wet-proof Indicator.** Protected from coolant, oil, oil fog, and other liquid contaminants. Seven models, four magnifications.

B **Series M Testmaster.** The Universal Test Indicator. Two styles. .001″ or .0001″ grads., eight models, plus non-magnetic.

C **Series L Testmaster.** Long range (.032″ and .060″), high magnification. Large or regular size dials, two styles. .0001″ or .0005″ grads., eight models.

D **Regular Dial Indicators.** Five sizes including A.G.D. groups 1 through 4. Over eighty different basic models plus thousands of variations.

E **Auxiliary Plunger** (new precision transfer unit) and new **Cam Type Lifting Lever** extend usefulness and preserve accurate reading of Federal Dial Indicators.

F **New style Tolerance Hands** set easily, lock securely. **Weights** for measurement of compressible materials. Made to your or A. S. T. M. specs.

G **Perpendicular Indicators.** Two sizes, seven models. Crown or spiral gear movement.

H **Long Range Indicators.** Wide variety of models up to 3″ range, .001″ to .0001″ grads.

I **Miracle Movement** greatly increases indicator life, improves performance. Available on all A.G.D. models . . . most other models.

J **Super-Sensitive Indicators.** Ultimate in indicator precision. Five models, .0001″ or .00005″ grads.

K **Dials** for any magnification. Also balanced, continuous, clockwise, counter-clockwise — with rev. counters, special markings, etc.

L **Attachments.** Right Angle or Hole . . . precision transfer units for checking "inaccessible" places.

M **Contact Points.** Many shapes, dozens of sizes. Polished tips, hardened steel, chrome, T.C., etc.

N **Backs.** Regular, offset, post, screw, adjustable, and flat. Special backs to order.

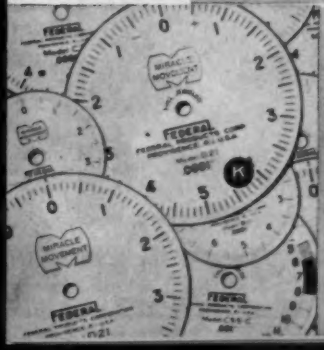
Ask for Catalog 58 describing the complete line of Federal Dial Indicators.

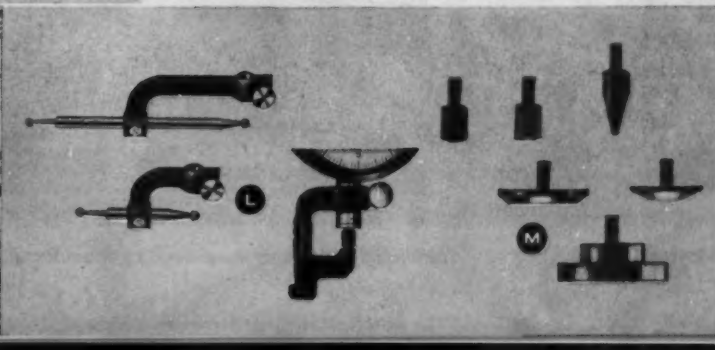
FEDERAL PRODUCTS CORPORATION
61210 Eddy Street • Providence 1, R. I.

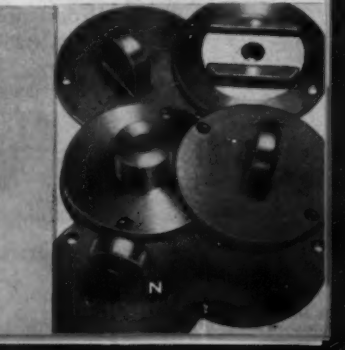
Ask **FEDERAL** *First*

for recommendations in modern gages . . .

Dial Indicating • Air • Electric, or Electronic — for inspecting, measuring, sorting, or automation Gaging







"What have you done about this DUST?"

In our plant trouble is spelled D-U-S-T. And our plastics production V.P. wanted to know what I had done to get rid of it. He was mad, and frankly, I didn't blame him. Dust was costing us a lot of money each year—in machine wear, misalignment and down time—to say nothing about absenteeism and poor morale among the workers. How could the plant help but be dusty—with grinders, lathes, milling and molding machines running 16 hours a day.

But I explained that I had checked on several dust control systems. The problem was that in 6 months we planned to expand and re-model the shop. It seemed like throwing good money after bad to invest in a control system now. But the V.P. wanted action. He told me about a Torit engineer who had called on him claiming he had a dust control system that offered complete *flexibility.* Then he gave me his card and suggested I call him immediately.

Believe me, I called that Torit man, but fast. He explained to me the flexibility his system offered—how with just minor changes it could be adapted to the new plant layout. I bought one of his Torit Model 24 Cyclone machines for less than $1,000. It services 2 molding machines, a double-end grinder, 2 lathes and a milling machine. And it really performs—has practically eliminated the dust in our shop. We're finishing our expansion and I have ordered another Torit Dust Collector to service our additional machines. You'd hardly recognize our shop now. It's clean. Production is up—morale is up—absenteeism is lower than ever.

Torit can solve your dust problems. For complete facts on dust . . . and how to control it . . . write

Cyclone Model 24

TORIT manufacturing company

1133 Rankin St., St. Paul 16, Minn., Dept. 432

Corinth Division of Kellogg Manufacturing Co, producer of electronic devices for missiles, is building an 82,500 sq-ft plant addition.

ISA to Continue Translation of Russian Technical Journals

Publication of four Russian technical journals, translated into English, will be continued with the 1960 issues during the coming year by the Instrument Society of America, under a grant from the National Science Foundation. The ISA "Soviet Instrumentation and Control Translation Series" is now in its fourth year and is carried on as a service to US scientists and engineers to afford a means for better information on latest developments in the field of Soviet instrumentation.

Included in the series are *Automation and Remote Control,* a 150-page monthly; *Measurement Techniques,* a 100-page monthly; *Instruments and Experimental Techniques,* a 175-page bi-monthly; and *Industrial Laboratory,* a 125-page monthly. The 1960 translations as well as those of previous years published under ISA's program, are available at subscription rates ranging from $20 to $35 per annual subscription. Further information can be obtained from Instrument Society of America, Foreign Translations Department, 313 Sixth Ave, Pittsburgh 22, Pa.

Ling-Temco Busy on Orders

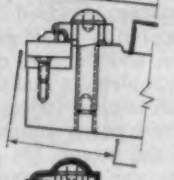
Classified contracts totaling more than $7 million have been awarded

"We settled this raise question in an arbitrary manner. I told him what I wanted and he told me where to go."

PRODUCTION RELIABILITY YOU CAN COUNT ON!

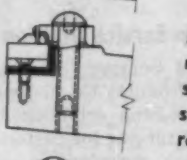
THAT'S WHAT YOU GET WITH THE VALENITE THROWAWAY INSERT HOLDER . . . AND HERE'S WHY:

Fully adjustable chipbreaker for complete chip control—A Valenite first, with five year record of dependable on-the-job performance.

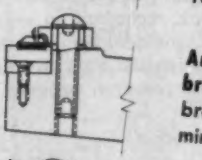


Shortest overhang—More tool in the tool post means greater rigidity.

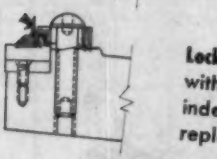
Lowest profile—Insures maximum chip clearance even in close quarters.



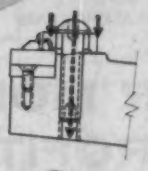
More accurate pocket—Special machining to rigid quality standards guarantees full insert support and fast, accurate indexing.



Area clamping contact, chipbreaker-to-insert—Prevents breakage from chip wedging, minimizes insert stress.



Lock-pinned chipbreaker—Stays with clamp when changing or indexing inserts, yet is fully replaceable.



Convenient, damage-proof clamp screw—Axial, straight line load design prevents clamp screw damage. Clamp screw is adjustable from top or bottom.

Cadmium plated, hardened tool steel shank—Rugged, rigid, and corrosion proof.

Carbide shim seats in three thicknesses—Provide insert cost saving.

Complete line—Over 200 styles and sizes, negative and positive rakes. There's a Throwaway Insert Holder for almost every machining need.

Large field service organization—Provides immediate delivery from stock in most areas, and competent service from experienced field engineers on any application, large or small.

The Valenite Holder is ready right now with time and job proven advantages for faster, more trouble-free production — a better product at less cost.

VALENITE METALS

SPEED AND FLEXIBILITY

— with cost-cutting Vertical Shapers

Easily set up and using the simplest tooling, the CHOMIENNE M-5" with its combination of longitudinal, transverse and rotary table movements, angular ram adjustment and ram speeds up to 270 strokes per min. solves production "problems."

Also available —
Vertical Shaper, 12" with 28¼" Rotary Table, 5 HP motor.
Horizontal Shapers, plain and universal 12" to 30" stroke, 2 to 10 HP motors

5" Vertical Shaper
12½" Rotary Table
2 HP motor

austin industrial corporation

76-F Mamaroneck Avenue White Plains, New York

CIRCLE 289 READER SERVICE CARD

MSO Since 1865

FOR MORE PROFITABLE GRINDING

For automatic production in plunge or traverse grinding MSO Hydraulic Grinders offer ease and speed of operation with single lever control, automatic cycling including variable spark-out to fine finish and preset size — against positive stop (repeat accuracy .00004") or by electric gauge.

Model FH-200 (Illus.) Swing 10"
Model FH-100 Swing 7"
Model FH-300 Swing 13¼"
Grinding lengths to 60"

MSO offers a complete line of precision grinding machines with features such as:

Automatic cycling
+ Precimatic sizing
+ Electronic Match Grinding

WRITE FOR LITERATURE ASK FOR REFERENCES

When only the best will do, check MSO first

austin industrial corporation

76-F Mamaroneck Avenue White Plains, New York

to Ling-Temco Electronics, Dallas. These orders increase to more than $19 million the new business announced since July 12 by Temco Aerosystems, a division of Temco Electronics & Missiles Co, subsidiary of Ling-Temco Electronics Inc.

Airborne electronic digital timing systems and complete digital data handling systems have been introduced to military markets by Temco Aerosystems which will do the work on the new contracts.

Aluminum Foils Inc . . .

. . . has changed its name to Consolidated Aluminum Corp. The Jackson, Tenn, firm is an independent producer of aluminum foil, coiled sheet, and super purity aluminum. Growth and diversification have necessitated the name alteration. In addition to making standard aluminum sheet and foil in varied gages, widths, tempers, and finishes, company has just completed a plant expansion program tripling its capacity to produce super purity aluminum and making it the largest US producer. The metal can be supplied in purities ranging from 99.99% to 99.999% and is available in a wide range of forms including pig, billets, pellets, coiled sheet, and foil.

Ampex Sets Up Service Division

Data Parts and Service Division of Ampex Data Products Co, Redwood City, Calif, has been established to provide special service for customers who use Ampex recorders in computers, for machine-tool control, and for acquiring scientific data in missile and satellite research programs.

"Why, there was an increase in your pay envelope this week, Taylor. Didn't your wife tell you?"

Only EX-CELL-O Contour Projectors* Give You ALL!

✓ CHECK THESE FEATURES!

☐ **LARGEST WORK AREA**—Constant eight inches of work space from lens to focal plane regardless of magnification. Plenty of room for large objects.

☐ **UNSURPASSED ACCURACY**—Famed Kodak Ektar® lenses guarantee reliable measurements with clear *accurate* images over entire screen.

☐ **BRILLIANT SURFACE ILLUMINATION**—Original design, "direct-on" built-in surface illuminator gives extra bright image and *full work clearance* at all magnifications.

☐ **ERECT—UNREVERSED IMAGE**—Correct, normal appearing images at all magnifications, eliminate confusion, simplify operation and save time.

☐ **COATED LENSES AND MIRRORS**—Produce clear sharp images characteristic of Ex-Cell-O Contour Projectors. Have been standard on all models for many years.

☐ **BRIGHT, GLARE-FREE SCREEN**—The "Fresnel" lens is exclusive with Ex-Cell-O, permits operator to see entire screen evenly illuminated from normal position. No "hot spots".

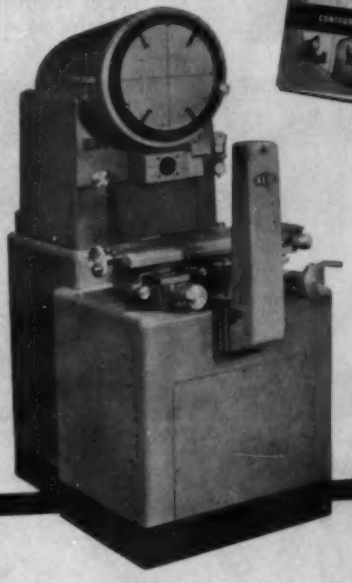
☐ **TRUE MEASURING PRECISION**—All Ex-Cell-O Contour Projectors not only read to tenths—they measure to tenths.

☐ **FINGERTIP CONTROLS**—Ex-Cell-O Contour Projectors are designed for maximum convenience and comfortable all day operation. Easy-to-reach controls.

☐ **RUGGED CONSTRUCTION**—The long established reputation of Ex-Cell-O for precision and quality assures years of trouble free operation.

☐ **YOUR OGP REPRESENTATIVE**—Will help you make sure you get the right Ex-Cell-O Contour Projector to fit your optical gaging requirements. Call him today!

Write for new edition of EX-CELL-O Contour Projector Booklet—Available Now!



*Manufactured by EX-CELL-O Corporation at Detroit, Mich.

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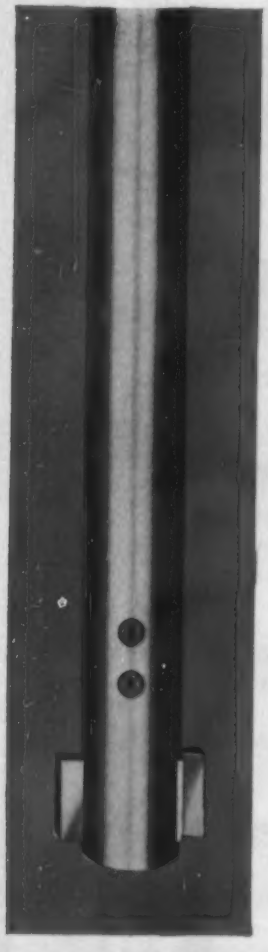
OPTICAL GAGING PRODUCTS, INC.

26 FORBES STREET ROCHESTER 11, N. Y.

(A subsidiary of EX-CELL-O Corporation)



WITH MADISON YOU GET A 100% DIVIDEND IN STOCK REMOVAL

You now get double the amount of stock removal for the same dollar investment when you use Madison's new DOUBLIFE® Reamer. The unique switch-over plate allows you to extend the cutting edges for hours of extra life.

What's more, you get all these dollar-saving features!

- Cutter adjustable in bar — cutter need not be removed from bar to make size adjustments. Diameter can be changed in seconds by simply turning adjusting screw.
- "Scissoring" eliminated — mating parts slide on a precision ground "V" and flat.
- Speed and Ease in Regrinding — You grind only two edges, then set accurately to size desired.
- Tolerances can be held to .0005" and the finish produced is from 50 to 100 R.M.S. depending on feed, speed and material.
- No floating holders are required — cutter has floating action in bar.

Get further information from your Madison representative or write for latest bulletin.

MADISON Industries, Inc.
P. O. BOX 1137, PROVIDENCE, RHODE ISLAND

FIELD REPORT

H-VW-M Triples Capacity At Grand Rapids Chemical Plant

Completed expansion at Hanson-Van Winkle-Munning Co's manufacturing facility at Grand Rapids has resulted in triple capacity for production of its recently enlarged line of proprietary and other chemicals for electroplating and other metal finishing. Facility has also been established as a new shipping point for Econ-O-Shape, regular and rectangular rolled carbon nickel anodes; complete processing operations are conducted at this plant.

Stolper Steel Products Corp . . .

. . . Menomonee Falls, Wis, is now Stolper Industries Inc. The 52-year-old company's Metal Products Div has for some time been fabricating parts from stainless steel, aluminum, and other non-ferrous materials, as well as in mild steel. Its Allen Div specializes in design and engineering of complete operator cabs, air conditioning, and military winterization. Acquisition of Plasticon Inc of El Monte, Calif, last May marked the company's entry into reinforced plastics, and speeded up the selection of a broadened name.

Redstone Machine & Tool Co . . .

. . . Huntsville, Ala, a firm which does general precision machine work in addition to building missile components and other products, is building a 580 sq-ft addition to its facilities.

"Try to hire all married men. They don't get upset when you yell at them."

Detroit
JOrdan 6-4767

Toronto
Ajax 1395

Cleveland
ACademy 1-6440

Chicago
COlumbus 1-7199

Youngstown
STerling 8-9661

Seattle
MUtual 1997

Cincinnati
TRinity 1-2520
and
EAst 1-8844

San Francisco
JUno 9-3050

we like to be close
to our customers

Erie
GLendale 5-9604

Los Angeles
LUdlow 9-3453
and
ANgeles 9-7304

New Haven
MAine 4-2375

Denver
BElmont 3-2333

and future customers!

Philadelphia
GArfield 6-6520

Houston
PArkview 3-3521

Atlanta
TRinity 5-8196
and
CEdar 3-2361

Nashville
CYpress 2-7016

Trenton
OWen 5-6205

Whether you want information on an application, or service on an existing installation, the Ajax Magnethermic man can give you assistance. He knows induction heating and melting.

induction heating is our only business!

Ajax Magnethermic CORPORATION

GENERAL OFFICES.....P. O. BOX 839 Youngstown 1, Ohio

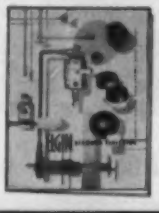
TRENTON DIVISION.....930 Lower Ferry Road Trenton 5, New Jersey

YOUNGSTOWN DIVISION...3990 Simon Road Youngstown 1, Ohio

ELGIN DIAMOND

COMPOUNDED TO YOUR SPECIFIC NEEDS

If you're not getting a *true* micro-inch surface or extremely close tolerances when finishing hard-to-work materials, call your Elgin field engineer. He is a diamond specialist and whatever the material . . . hardened steels, carbides or ceramics . . . he will solve the problem of precision polishing and finishing by recommending an Elgin Diamond compound for your specific application. The Elgin Diamond compound he selects will be of the right grading and concentration for the best performance on your job. Your Elgin field engineer carries a microscope and will conduct an exacting visual inspection under actual production conditions at your plant. Write for the complete Elgin Diamond Compound catalog. For special assistance on your polishing or finishing problems call your local Elgin Diamond specialist or write:



Abrasives Division
ELGIN NATIONAL WATCH COMPANY
ELGIN, ILLINOIS

CANADIAN DISTRIBUTOR: B.S.A. TOOLS LTD.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

MACHINES AND ATTACHMENTS

1 GISHOLT MACHINES — *Gisholt Machine Co, 1245 E Washington Ave, Madison 10, Wis.* 12-page condensed catalog, form 1126-N, contains illustrated, brief descriptions of Masterline machines. Section on manually operated ram type and saddle type turret lathes now includes the completely new and entirely automatic AR turret lathe and the redesigned Fastermatic automatic chucking turret lathe with FeeDial. Included in the line are automatic chucking lathes, the Cri-Dan high-speed, semi-automatic, single-point threading lathes, Superfinishing machines, balancing machines, and the JETracer attachment. Section is included on Masterglas custom-molded fiberglass reinforced plastic products.

2 BORING AND MILLING MACHINES—*DeVlieg Machine Co, Fair St, Royal Oak, Mich.* 12-page illustrated publication SJ-106-9-60 describes features of the Spiramatic Jigmil machines for one-piece or production operations. Discusses advantages of new direct-dial dimension system called Diatrol, and the numerical tape control system designated Tapac. Also covers the Micropoint tool grinder that grinds single point tool profiles geometrically correct to gage accuracy; automatic functions and accessories for the Spiramatic Jigmils; machine specifications; and tooling systems developed for handling HSS, carbide, and ceramic cutting tips in boring, facing, turning, and multiple cuts.

3 PRECISION SPEED LATHE—*Rivett Lathe & Grinder Inc, Brighton 35, Boston, Mass.* 6-page bulletin illustrates and describes the Rivett 60 Series that incorporates one-motion control. Single lever starts lathe spindle, selects any speed up to 4800 rpm, changes speed during operation, or instantly stops or reverses spindle.

4 NUMERICAL MACHINE TOOL CONTROL — *Westinghouse Electric Corp, Systems Control Dept, PO Box 2025, Buffalo, NY.* 4-page bulletin presents illustrated data on PRODAC (programmed digital automatic control), the first numerical control system employing all-static, all-transistorized circuitry. The system can be tailored to fit almost any

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- **RATINGS** easily handle solenoid loads. AC pilot duty rated 690 VA. Continuous rating 10 amperes, 125 volts AC for plug-in construction and 277 volts AC for terminal connection
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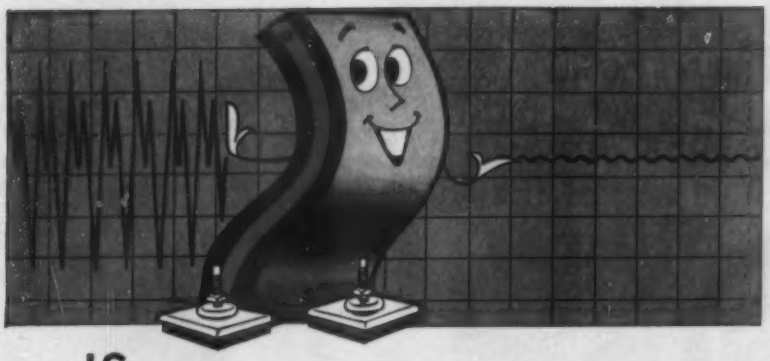

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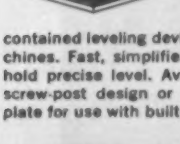

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machine tool and is reported to be ideally suited to drilling, boring, turning, shaping, riveting, milling machines, presses, and stamping machines.

5 CHINES — *Foote-Burt Co, Cleveland* SURFACE BROACHING MA-*8, Ohio.* 6-page brochure gives information on line of continuous horizontal surface broaching and vertical surface broaching machines. Typical parts produced are illustrated. The vertical machines have 5, 10, 15, and 25-ton capacities. Broach stroke in the vertical models extends to 66 in. Stroke length in the horizontal models is 40 to 140 in.

6 METALWORKING MACHINE — *Wales Strippit Inc, Akron, NY.* 8-page catalog 308 describes features of the Super 30 Fabricator, a multi-purpose, single-station sheet metalworking machine with 30-in. throat depth for prototype and short or medium production runs. Explains how precision micrometric gaging enables the operator to position work faster and more accurately, how swing-shift punch holders and drop-in die buttons allow tools to be changed in as little as 20 seconds. Accessories include the Strippit Duplicator which reproduces any complex hole pattern for production runs.

7 GRINDING AND FINISHING MACHINERY—*Sales Service Mfg Co, 2362 University Ave, St. Paul 14, Minn.* Brochure TM860 gives details on Tri-Matic oscillating belt grinders, 12 through 48-in. sizes, with specifications and typical applications. Also describes oscillating sheet surfacer using abrasive impregnated nylon.

8 BAR STOCK CUTOFF MACHINE —*Salem-Brosius Inc, PO Box 2222, Pittsburgh 30, Pa.* Illustrated brochure probides information on the Reactron torque cutting bar stock cutoff machine built in three sizes for stock up to 1, 2, and 2¾ in. dia. It will cut round, square, hexagon, octagon, and many other of the standard bar shapes. Metals cut include aluminum, brass, titanium, steel, and other structural metals and, depending upon tensile strength or elongation of the metal, it will cut short lengths as small as 1/3 the bar diameter. Unit will cut heat-treated bar stock without prior anneal.

9 METAL SPINNING—*Phoenix Products Co, Metal Spinning Division, 4715 N 27th St, Milwaukee 9, Wis.* Bulletin describes Phoenixspun Powerspinning, a new development in metal processing that makes possible the highly accurate spin-

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ning of even the toughest alloys—chrome-moly steels, the stainless steel alloys, titanium, high-strength aluminum alloys—in thicknesses up to 2 in., diameters of 170 in.

10 DIVIDING HEADS — *Vinco Corp, 9111 Schaefer Hwy, Detroit 28, Mich.* 8-page brochure describes applications, accuracy, operation, and floor space of three models of the Vinco Optical Master Inspection dividing head. Charts on the inspection of tooth spacing of gears and splines; cam contour measurement; and calibration of involute profiles are included together with a condensed content of the Vinco Angular Spacing book.

TOOLS AND ACCESSORIES

11 THREADING TOOLS — *National Acme Co, Threading Tools Division, 170 E 131st St, Cleveland 8, Ohio.* 44-page bulletin DT-60 pictures and describes complete line of Vers-O-Tool self-opening threading and hollow milling heads, collapsible and solid adjustable taps. In addition, the new line of 5-chaser Vers-O-Tool heads for revolving and non-revolving spindles are listed. Also covered are specifications, parts lists, ordering instructions, and thread data.

12 MULTIPLE SPINDLES — *Gardner-Denver Co, Quincy, Ill.* 12-page bulletin provides information on wide selection of multiple spindles for production nut setting. Power units are available to meet torque requirements to over 200 ft-lb. In the basic power units there are wide ranges of speeds and torques from which to choose. Both center type and offset spindles are available. New 16J-3 series has speed range of 340 to 1300 rpm. Soft draw torque range at 90 psi is 5 to 45 ft-lb. The 16J-5 model speed range is 175 to 1750 rpm with soft draw torques from 12 to 188 ft-lb at 90 psi.

13 CARBIDES—*Adamas Carbide Corp, Kenilworth, NJ.* 36-page price list 960 gives specifications and new prices on complete line of tungsten carbide tools, tool tips, dies, wear parts, and Dex-A-Tools.

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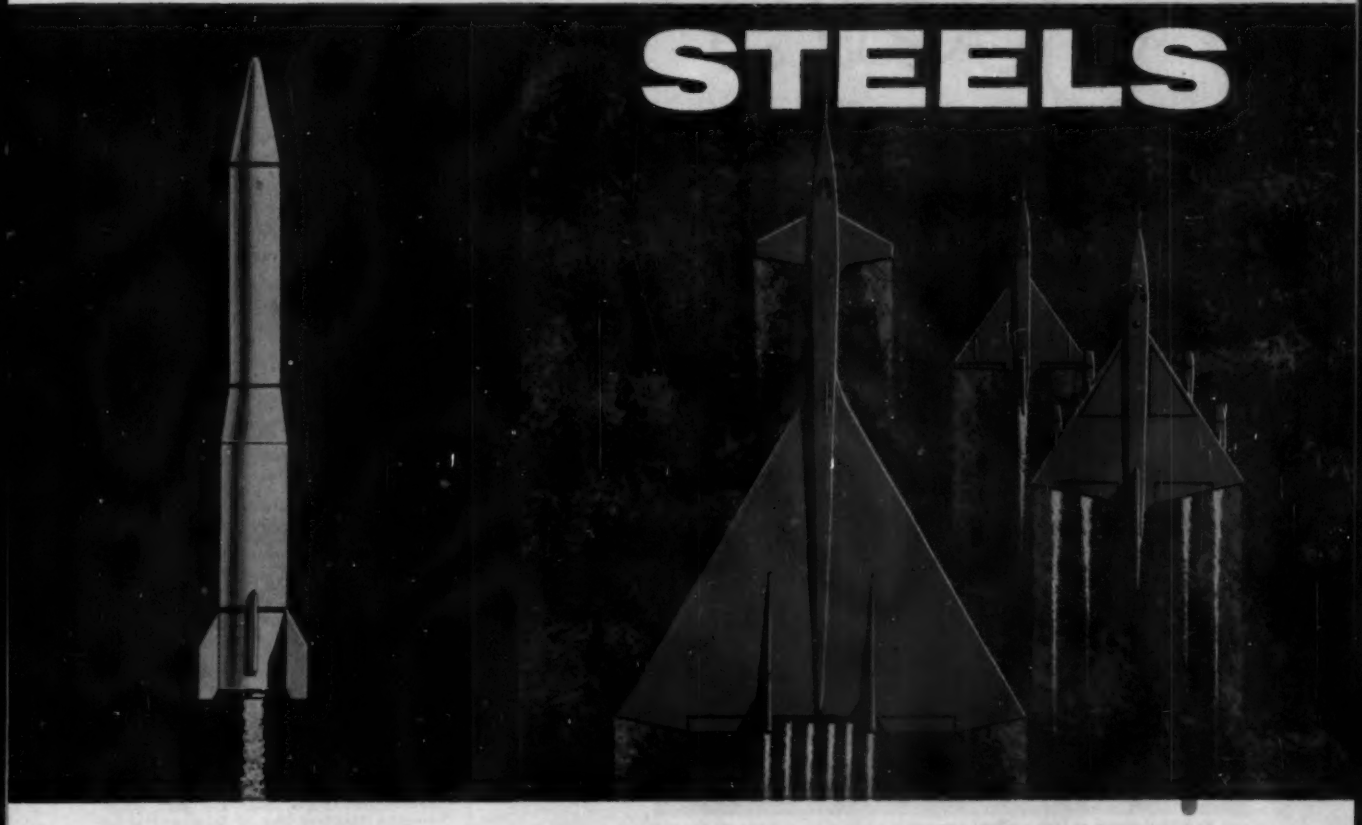

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What CVM does for a fine air-melted steel: VASCOJET 1000

EFFECT OF CONSUMABLE ELECTRODE VACUUM MELTING ON TRANSVERSE DUCTILITY OF VASCOJET 1000 AT 280-310,000 PSI

Representative billets and bars from multiple heats. Four to six tensile bars cut transversely from midradius of each piece and heat treated to 280-310,000 psi ultimate tensile strength.

Cross Section	Avg. Transverse Reduction of Area (280-310 ksi) Consumable Vacuum Melt	Air Melt
16" square	21%	7%
12" square	22	10
9½" round	27	11
9" square	30	11
7" round	31	12
7" square	35	12

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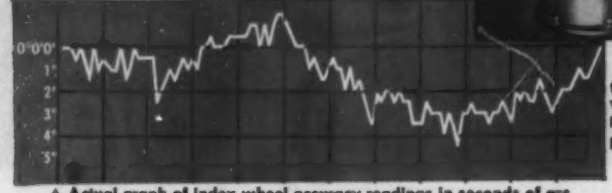
SUPERIOR TESTING METHODS

give you gears cut to maximum accuracy and precision

◀ Theodolite accurate to within 0°-0'-0.2" of arc being used to check indexing of 154" gear shaper



▲ Special 154" gear shaper reworked by BRAD FOOTE for cutting precision gearing

▲ Actual graph of index wheel accuracy readings in seconds of arc at each 3° (rotation) interval

BRAD FOOTE's constant striving for higher quality leaves nothing to chance. Constant checking of all gear-cutting machines assures all gears are cut accurately to the closest possible tolerances.

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14 FLEXIBLE SHAFT HANDBOOK—*S S White Industrial Division, Dept P, 10 E 40th St, New York 16, NY.* 89-page indexed handbook, completely revised fourth edition, presents simplified approach to the selection of flexible shafting through standard, pre-engineered, or custom-designed units. Information included on a new, simplified engaging system based on integral formed square drives, and the improved Series 7 (remote control) and Series 9 (power drive). Describes advantages of flexible shafts, their function, applications, basic data on standard power drive and remote control shafts, use of adapters and other accessories, and a section of tables and statistics.

15 MEASURING INSTRUMENTS — *Tubular Micrometer Co, St James, Minn.* 6-page illustrated brochure contains data on Scherr-Tumico O-Vee gages for measuring of thread pitch diameter, and O-Vee screw thread comparator. 4-page companion brochure describes and pictures the Scherr-Tumico Linearscope with a 4 x 12-in. coordinate travel.

16 GAMMA RADIOGRAPHY—*Radionics Inc, Lafayette & Water Sts, Norristown, Pa.* Illustrated data sheet provides information on Model 60-1000 Gammatron with a capacity of over 3000 curies of cobalt 60. It provides 2 MeV radiography for not much more than the cost of a 250 KVP X-ray machine. Exposure times are low, and radiographic quality is said to be at least equal to that of a 2 MeV X-ray machine. Components and operation are discussed; safety features and specifications are listed.

17 FORM TOOLS AND BLANKS — *Somma Tool Co, 109 Scott Rd, Waterbury, Conn.* 4-page supplement to catalog 58 describes recent additions to line of standard form tools and blanks for automatic screw machines. New items include solid carbide cutoff tools; straight blade cutoff tools made from T-5 high cobalt steel; a standard line of form and cutoff tools for producing American Standard machine screws with flat, round, fillister, or oval fillister heads; and hardened dovetail form and shave tool blanks. Specifications and prices on all sizes included.

18 "TOOLING INFORMATION SERVICES—*Detroit Tooling Association, 108 Pallister Ave, Detroit 2, Mich.* 6-page magazine to be published monthly by the Association (formerly known as the Automotive Tool & Die Manufacturers Asso-

"Don't let his gruff exterior fool you. On the inside he's even gruffer."

Down-to-earth reasons for using Custom Quality OHIO Tubing

As in rotary drilling, which uses steel tubing internally upset by Ohio Seamless, greater strength and lighter weight may be important in your product.

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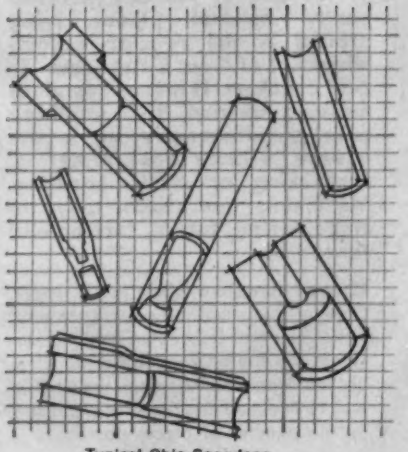
Model illustrated built to 3.5 mm scale.



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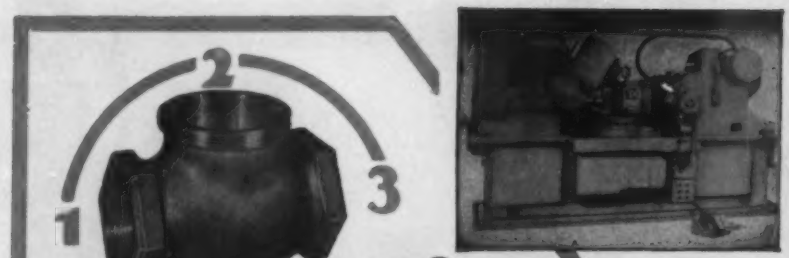
CANADA: Railway & Power Eng. Corp., Ltd. • EXPORT: Copperweld Steel Int. Company, New York 7, New York



GOSS & DE LEEUW AUTOMATIC CHUCKING MACHINES

perform one to three operations in sequence or simultaneously . . .

TO CUT PRODUCTION COSTS...

More completely finished parts at the end of the day with no partly finished pieces lying around is the regular accomplishment of Goss & DeLeeuw "1-2-3" chuckers. It means complete finishing on one, two or three ends simultaneously or in sequence without tool resetting, rechucking or parts handling. Machining operations may include boring, facing, turning and threading.

Change over from job to job is simple. Cost-cutting is assured on long or short runs. Goss and DeLeeuw Chucking Machines are the only standard machines of their type which operate the "1-2-3" way to reduce costs per piece and step up the number of pieces per hour.

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Investigate the opportunities offered by these machines on your production by sending samples of your work for time and cost estimates—Ask for illustrated descriptive literature.

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ciation) is available to anyone interested in dies, jigs, fixtures, molds, gages, tools, special machinery, and related products. The initial September issue contains an article on the production and tryout of English car dies in Detroit. To receive monthly copies, send name, company affiliation, and address to Chester A Cahn, Managing Director, Detroit Tooling Association.

19 PUMP UNITS FOR MACHINE TOOLS — *Ruthman Machinery Co, 1309 Reading Rd, Cincinnati 2, Ohio.* 4-page bulletin illustrates and provides tabular data on gusher tank units for supplying coolant to machine tools not equipped with a coolant pump. They also may be used as portable, or auxiliary systems. Tank capacities range from 4 to 50 gal.

20 "A B C OF MODERN LUBRICATION" — *Bijur Lubricating Corp, 151 W Passaic St, Rochelle Park, NJ.* 4-page bulletin describes and pictures the three basic elements of automatic lubrication: lubricators, distribution systems, and Meter-Units. Eight types of automatic lubricators are shown. Distribution system details are given. Third section covers the Meter-Unit which regulates amount of oil flow at each bearing.

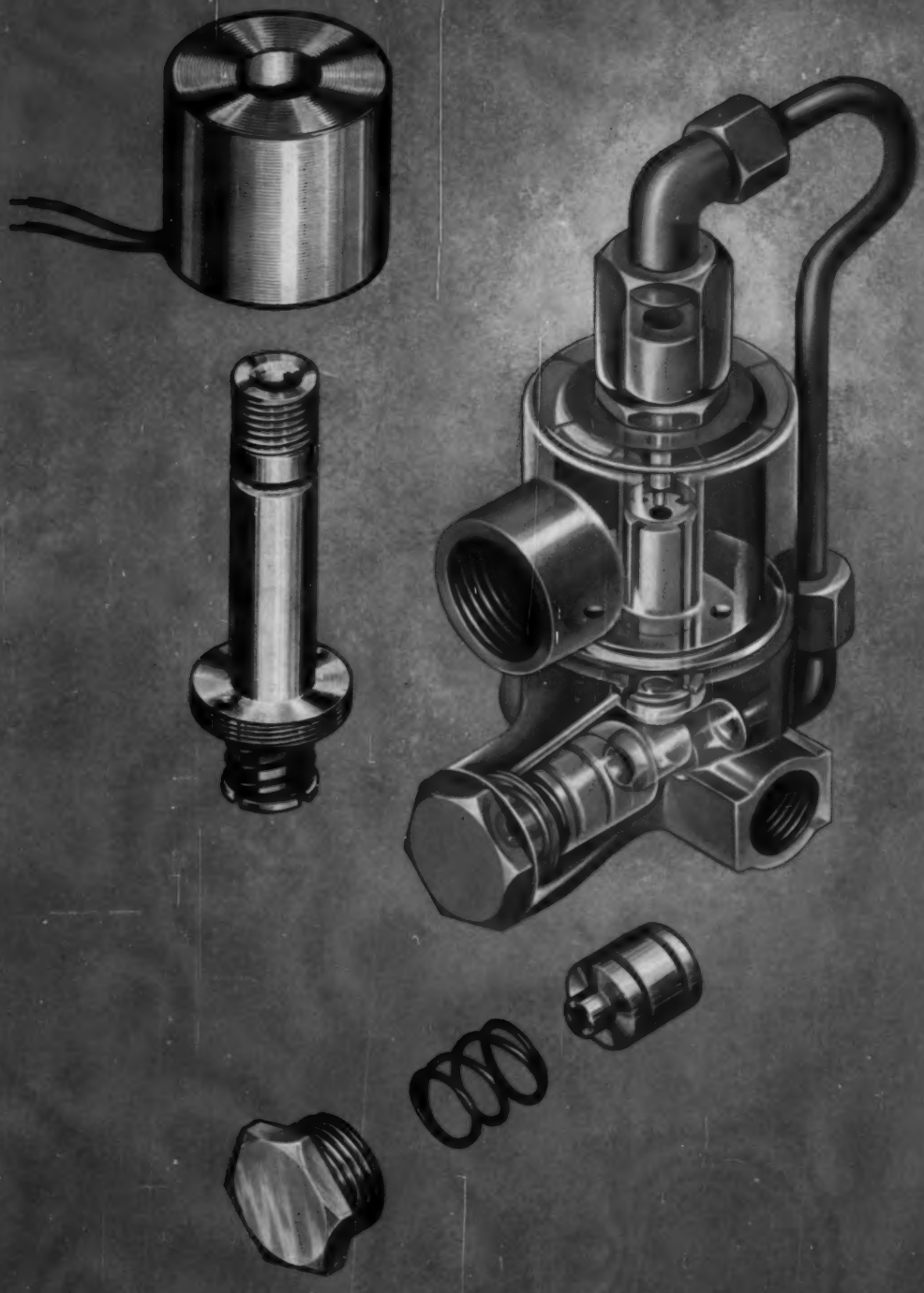
● DRAWING AND MEASURING INSTRUMENTS—*Alvin & Co, Windsor, Conn.* 124-page catalog covers complete line of equipment including advanced drawing sets; drawing instruments; designing aids (templets for electronic, tool design, and other fields); drawing equipment; drafting materials; computing and measuring devices; magnifiers. Request direct on company letterhead.

HEAT TREATING AND WELDING

21 RESISTANCE WELDERS — *Federal Machine & Welder Co, Warren, Ohio.* 12-page brochure BT-60 illustrates and describes line of resistance welders in all phases, spot, projection, seam, roll seam, portable, aircraft spot and seam, flash, multi-spot and automated.

22 WELDING ALLOY MANUAL—*All-State Welding Alloys Co, 249-55 Ferris Ave, White Plains, NY.* 56-page welding, brazing, and soldering alloy and flux catalog and instruction manual gives physical properties, major uses, detailed application instructions, and latest tech-

(Continued on p 209)

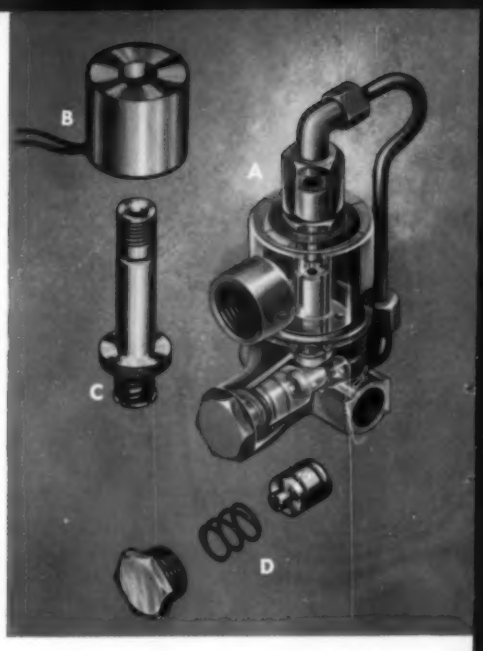


SKINNER 2-way Solenoid Valves

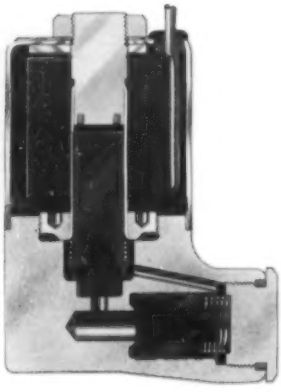
for high flow, high pressure applications

Here's how Skinner two-way valve design provides long lasting, trouble-free operation

- **Underwriters' Laboratories approved**
- **Stainless steel internal parts resist corrosion**
- **Forged naval brass body**
- **Famous Skinner V5 solenoid operator**
- **Well rounded main orifice and pilot seats**



A—Transparent view of normally open 2-way R type valve with piped pilot exhaust return
B—Coil C—Sleeve, plunger and spring assembly
D—Piston assembly with soft synthetic insert



NORMALLY CLOSED TYPE R2

When you have high-flow control problems at standard or high pressures the new Skinner two-way R series valves may be the answer. These pilot-operated solenoid valves are designed for use with air, oil, water, inert gases and other common media at operating pressure differentials of 5 up to 1250 PSI. They may be used for all types of control applications, such as: in high-pressure lifting, commercial laundry equipment, machinery, machine tooling, spraying, etc.

Skinner R series two-way valves have forged naval brass bodies to provide a dense metal structure and use a foolproof stainless steel piston with soft synthetic insert to open and seal the main orifice. Types are available normally open or normally closed, in standard and explosion-proof construction.

To make installation easy for every application, a wide choice of electrical housing options is available. These include JIC, AN connector, automotive terminals, etc. All housings can be rotated 360°. Manual override is also offered to permit manual opening of normally closed valves, or closing of normally open valves, in emergency.

Skinner R series valves may be used with all common voltages and frequencies and there are several coil types such as: varnished, molded waterproof, tropicalized and high temperature for specific applications.

The R series, illustrated here, is just one in a complete range of 2-, 3- and 4-way Skinner solenoid valves.

TWO-WAY R SERIES SPECIFICATIONS

Types	R2 XR2	R2H XR2H	R2H6	RP1 XRP1
Position	Normally closed	Normally closed	Normally closed	Normally open
Pipe Size (NPTF Dry Seal)	¼"	¼"	¼"	¼"
Orifice Size	¼"	¼"	¼"	¼"
Cv Factor	.758	.758	.758	.758
Operating Pressure Differential (PSI) Minimum	5	5	5	5
Maximum AC Service	200	1250	—	150
Maximum DC Service	200	500	1000	150
Leakage	Bubbletight	Bubbletight	Bubbletight	Bubbletight
Temperature Range (Ambient and Media)	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F	Minus 40°F to plus 180°F

When you specify solenoid valves, specify Skinner. Skinner solenoid valves are distributed nationally.

For complete information, contact a Skinner Distributor listed in the Yellow Pages or write us at the address below.

SKINNER ELECTRIC VALVES®
THE CREST OF QUALITY

SKINNER ELECTRIC VALVES

SKINNER ELECTRIC VALVE DIVISION,
THE SKINNER CHUCK COMPANY • NEW BRITAIN, CONNECTICUT, U.S.A.

PRINTED IN U.S.A.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

niques for welding, brazing, soldering, cutting, and hardfacing. Charts and tables summarize alloy selection and properties. Products are indexed by major metal use. Practical short-cuts, helpful hints, and data on automatic and semi-automatic welding wire are included.

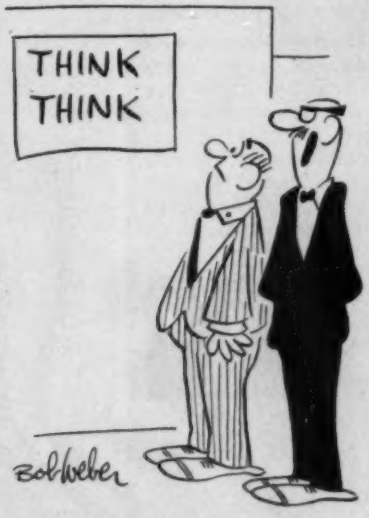
23 FLAME HARDENING EQUIPMENT—*Air Reduction Sales Co, 150 E 42nd St, New York 17, NY.* 12-page brochure, form ADC 704A, illustrates and describes various problems of oxy-acetylene flame hardening and shows how they can be solved with Airco equipment. Equipment discussed ranges from standard heating torches and tips and water-cooled flame hardening torches to gear hardening equipment adapted to use with the No. 20 Radiagraph, a portable machine carriage that operates on a tongued and grooved steel track.

24 WELDING ELECTRODE CHART —*Hobart Brothers Co, Troy, Ohio.* 23 x 35-in. wall chart gives description, number, color code, mechanical properties, size, current range, procedure, and application information on the complete line of arc welding electrodes. Includes welding symbols, welding arc, causes and cures of common welding troubles, typical deposition rates, and a metal hardness conversion table.

25 ULTRASONIC JOINING UNIT — *Raytheon Co, 1415 Boston-Providence Turnpike, Norwood, Mass.* Data sheet 2-380 describes features and operation of Model 2-380 designed for working with materials which previously were considered to be too difficult to wet with fluxless solder or to weld, such as aluminum, silicon, germanium, or ferrites. Unit consists of three major components: an electronic generator; a handpiece assembly with cable and plug; and an on-off foot control switch and cable.

26 MANIFOLDS AND REGULATORS —*Linde Co, 270 Park Ave, New York 17, NY.* 16-page catalog, form 55-085, contains illustrated descriptions of Oxweld industrial gas regulators and portable manifolds. Gives specifications for regulators that are available for use with

(Continued on p 213)



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Wheelock, Lovejoy maintains seven strategically-located warehouses to serve the needs of its customers. Each warehouse is fully staffed by metallurgists of long experience, ready to advise you as to grades, applications, heat treating, etc.

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WHEELOCK, LOVEJOY & COMPANY, INC.

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STEEL SERVICE CENTER INSTITUTE

New! The most reliable limit switch ever developed

(from Cutler-Hammer, of course)

Limit switch failures cause more production down time than any other electrical component. Suddenly this problem has been greatly reduced by the new Cutler-Hammer oiltight limit switch. Under test conditions much tougher than in actual production, it lasted far longer than any other limit switch.

It fits almost anywhere and in any position. A simple field adjustment changes switch operation to close the contacts by lever motion that is clockwise, counterclockwise, or both. And, no other switch is sealed more effectively. Even the silver-to-silver contacts are visible for quick inspection. Send for Pub. ED143-U239 now for full details.

What's new at Cutler-Hammer? We're planning ahead—with new, *better* products, like the limit switch. We've added plant capacity, new engineering talent and our new trademark symbolizes our new capabilities to help you plan ahead. Call the nearest Cutler-Hammer sales office or distributor to see how we can fit into your team.

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LIMIT SWITCH
NO.
WITH SELECTED OPERATOR
AMPERE RATINGS
VOLTS
AC
DC
AC INRUSH
115
15
0.5
40
230
10
0.2
20
460
6
—
12
600
5
.02
8

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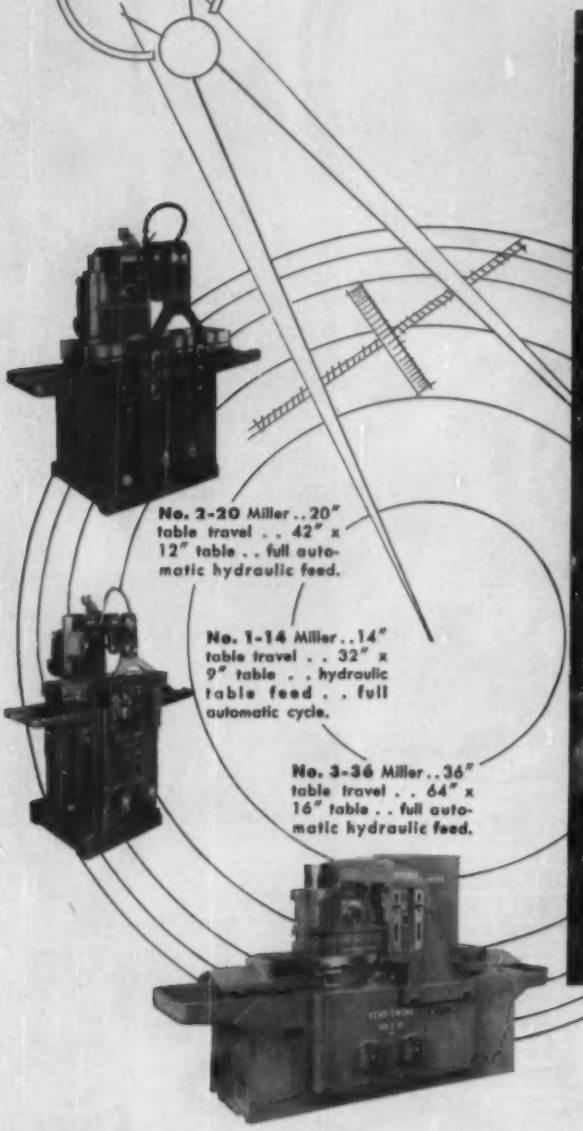
in Milling Machines..Special Machinery..Automation Equipment



No. 2-20 Miller..20" table travel . . 42" x 12" table . . full automatic hydraulic feed.

No. 1-14 Miller..14" table travel . . 32" x 9" table . . hydraulic table feed . . full automatic cycle.

No. 3-36 Miller..36" table travel . . 64" x 16" table . . full automatic hydraulic feed.

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Know-How, born of years of experience, abetted by sound and imaginative design and quality manufacturing standards . . . is the reason why many of our customers, representing a wide and diversified coverage of industry, come back to us again and again for *answers* to their production problems.

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Write or call . . . Kent-Owens will be pleased to quote your requirements. Kent-Owens Machine Company, Toledo 10, Ohio.

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all industrial gases, and manifolds for use with oxygen and acetylene. Recommended uses and installations are included for each. In addition to covering single and two-stage regulators for station and manifold service, catalog also describes a new line of single-stage regulators without gages.

PLANT SERVICE EQUIPMENT

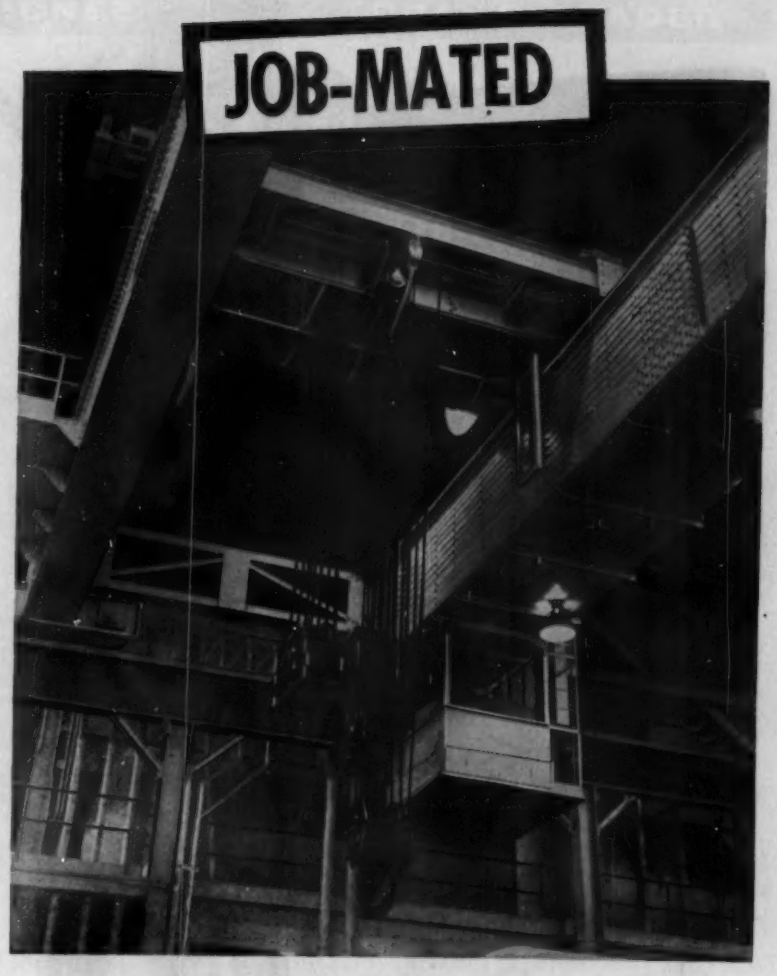
27 CONVEYORS—*Rapids-Standard Co, 343 Rapistan Bldg, Grand Rapids 2, Mich.* 44-page illustrated catalog GC-1 has been revised to include new sections covering APC (adjustable pressure conveyor) wheel and live roller models and Rapisteel slotted angle construction material. New techniques and applications of materials handling equipment and systems are pictured and diagrammed. Subjects covered include principles of a coordinated system, gravity conveyors; powered conveyors; framing material and live storage racks overhead conveyors; special use conveyors; conveyor system accessories, casters, wheels, and hand trucks.

28 HEAT TRANSFER EQUIPMENT—*Young Radiator Co, Racine, Wis.* 32-page catalog 160 covers radiators, heat exchangers, Super-charger air coolers, and heating and air conditioning products. Installation photos included.

29 DUST CONTROL — *American Air Filter Co, 215 Central Ave, Louisville 8, Ky.* 12-page bulletin 271 describes complete line of equipment. Discusses the four main types of products: dry centrifugals, wet collectors, fabric collectors, and electrostatic precipitators. Thirteen different products illustrated; capacities and applications given.

30 DRY-TYPE TRANSFORMERS — *General Electric Co, Schenectady 5, NY.* 24-page publication GEA-6907A contains selection and application data on full line. Prices, dimensions, and specifications provided for single and three-phase general purpose transformers, autotransformers, buck-boost transformers, as well as for distribution and voltage-stabilizing transformers.

"The main difference between the night shift and the other two shifts is me."



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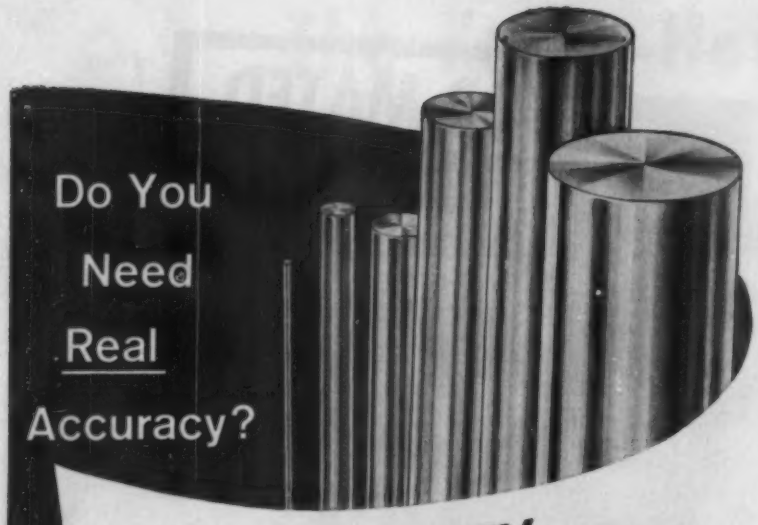

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31 SHIPPING CONTAINER MOUNTING SYSTEMS—*Lord Manufacturing Co, Erie, Pa.* 16-page bulletin describes how engineered protection against shipping/handling damage can be achieved with elastomeric mounting systems custom-designed by Lord. Design guide enables packaging engineers to gain understanding of the factors involved in a suspension system and get a quick approximation of drop height, deflection, fragility factor, and system natural frequency. Various types of elastomeric mountings used in shipping container systems are described.

32 MOBILE HYDRAULIC CRANES—*Ruger Equipment Inc, 615 W Fourth St, Urichsville, Ohio.* 8-page bulletin 3000 covers complete line of multi-purpose cranes with on-the-job pictures of general as well as special applications. Descriptions and illustrations included of accessory equipment such as electric power packs, extension booms, barrel grips, crane wells, stack or lift attachments, and stabilizers. Line of cranes includes models with capacities from 500 to 6000 lb.

33 WATER SENTINEL—*Ipsen Industries Inc, PO Box 500, Rockford, Ill.* Bulletin WS-60 provides data on installation and operation of a safety device that detects water in enclosed type oil quench tanks. Components illustrated; graph shows response time for different water contamination levels of quenching oil. Device can be used with any sealed quench tank that has good circulation or agitation.

PARTS AND MATERIALS

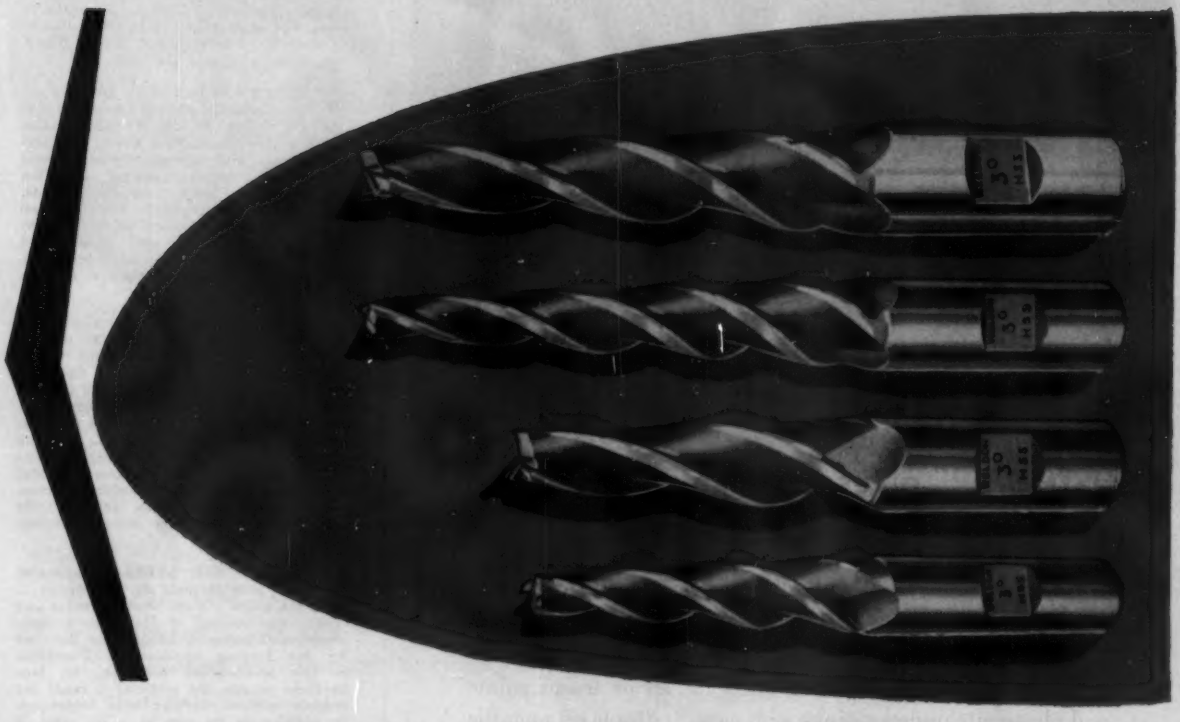
34 PARALLEL SHAFT SPEED REDUCERS—*Link-Belt Co, Prudential Plaza, Chicago 1, Ill.* 36-page book 2719 describes completely redesigned and expanded line available in 57 sizes including 23 new sizes. Single, double, and triple reduction units are furnished in capacities up to 2800 hp at high or low output speeds, and ratios up to 292:1. Sixteen pages of rating tables contain thermal and mechanical horsepower ratings for each input and output speed. Load classes are shown for 250 driven machines. Overhung loads, extended shafts and outboard bearings, dimensions, and actual ratios are included.

"Jim Carter told me he's doing the work of two men and he named names."

YESTERDAY'S PIONEER . . . TODAY'S LEADER

WELDON / TAPERED END MILLS

DIE SINKING CUTTERS
CONSTANT SPIRAL FLUTES



• The extensive line of the well known Weldon End Mills includes Tapered End Mills, Constant Spiral. Also known as Die Sinking Cutters, these end mills, filling a definite need, come in a wide range of sizes, giving a choice of many lengths and diameters.

Weldon Tapered End Mills as standard stock items are all 3-flute, and offer a choice of ½°, 1°, 1½°, 2°, 3°, 5°, and 7° angles, taper on side. They represent the same high quality for which all Weldon End Mills are famous.

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For a single tank cleaner to do many jobs

ask Oakite

OVER 50 YEARS CLEANING EXPERIENCE • OVER 250 SERVICE MEN • OVER 160 MATERIALS

"RUSTRIPPER" gives you the "universal" tank cleaner . . . removes rust, scale, paint, soils

Here is a remarkable alkaline material with powerful cleaning and chelating action. It conquers a wide variety of soils. In a tank of Oakite RUSTRIPPER, you can remove scale and rust with complete safety. It strips tough paints and phosphate undercoatings with ease. It cleans off metallic smuts, light shop soils, discolorations.

Look at its performance in shop service: "Aircraft parts freed of scale with boiling soak, instead of sand blasting" . . . "oil, welding flux, rust removed in job plating" . . . "soaked steel wrenches give brighter plate" . . . "removes all rust, scale, carbonized oil from diesel liners prior to plating" . . . "displays amazing solution life even though worked very hard" . . . "eliminates pickling and precleaning for barrel-plated screws" . . . "does to bolts in 3 minutes what took pickling 40 minutes". *And that's just a sample.*

Write for Bulletin 9651. Better yet, ask the Oakite man. Oakite Products, Inc., 28A Rector Street, New York 6, N. Y.

it PAYS to ask Oakite

OAKITE

over 50 years' leadership in industrial cleaning

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35 COBALT ALLOYS—*Cobalt Information Center, c/o Battelle Memorial Institute, 505 King Ave, Columbus 1, Ohio.* 4-page data sheet on new cobalt-base and nickel-base super-alloys lists physical and mechanical properties, corrosion resistance, thermal treatment, fabrication, available forms, and applications of 18 alloys including Nivco 10, J-1570, J-1610, WI-52, Nicrotung, Inco 717C, and Unitemp 1753.

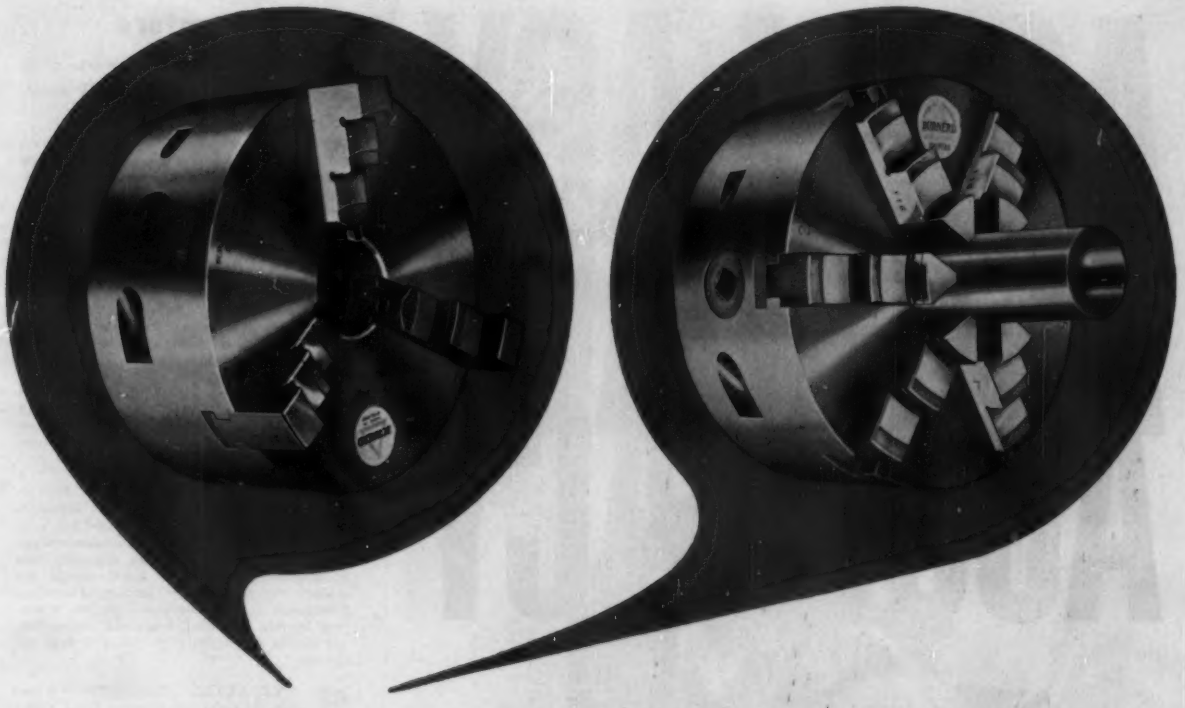
36 ELECTROMAGNETIC DRIVES — *Westinghouse Electric Corp, PO Box 2099, Pittsburgh 30, Pa.* 12-page booklet B-7875 covers MagnaFlow drives for conveyors, fans and pumps, winders, metal slitting and forming machines. Describes how these drives work, what they include, and where they are used. Various types discussed include air-cooled drives both integral and fractional, and liquid-cooled units. Excitation system, optional operating functions, and mechanical features of each are described.

• COMMERCIAL GLASSES—*Corning Glass Works, Corning, NY.* 16-page booklet B-33 is a revised edition of "Properties of Selected Commercial Glasses." Publication details properties of 32 glasses, and contains information on several new ones as well as new sections on thermal expansion and optical properties. Includes temperature chart for converting Fahrenheit to Centigrade and reverse; thermal stress, heat transmission, electrical properties, corrosion resistance, and viscosity data. Request direct on company letterhead.

37 ALLOY DIE STEEL—*Heppenstall Co, 4620 Hatfield St, Pittsburgh 1, Pa.* Data sheet 1 gives characteristics and typical applications of Hardtem, a chromium-molybdenum-vanadium alloy die steel for hot forging applications. Furnished in the prehardened condition, in four hardness ranges, the material is ready for sinking without further heat treatment. In addition to its uses as a die steel, it is recommended for such machinery and extrusion components as containers, backer-up blocks, ejector blocks, bushings, pinion shafts, pinion gears, and miscellaneous shafting. Instructions for forging, annealing, hardening, and tempering are provided together with properties at room and at elevated temperatures.

38 HYDRAULIC EQUIPMENT — *John S Barnes Corp, 301 S Water St, Rockford, Ill.* 8-page condensed catalog EJS covers machine tool and industrial hydraulics including application recommendations.

"There, there, we've all got to go sooner or later."



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UNEQUALLED ACCURACY

Burnerd 3-jaw and 6-jaw GRIPTRU chucks give you concentricity *within* .0002″ total indicator reading.

QUICK SET-UP

In one minute or less, with GRIPTRU's exclusive micro-adjusting mechanism, you center your initial work piece to the required tolerance.

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With a GRIPTRU, you chuck duplicate parts *at scroll chuck speed* to the same accuracy *without further adjustment.*

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Burnerd GRIPTRU chucks are built to retain their greater accuracy under toughest conditions. Bodies are Meehanite, scrolls are heat-treated alloy steel forgings, pinions are case-hardened nickel steel, jaws are case-hardened steel.

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Every Burnerd chuck is *guaranteed* against defects in material and workmanship *for a period of two years,* and is backed by the coast-to-coast sales and service organization of Clausing.

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You don't pay a premium for GRIPTRU's superior features. The cost is actually *less* than for ordinary scroll chucks. For example, a 6″ 3-jaw GRIPTRU is only $96.00 —a 12″, $220.00!

Investigate Burnerd before you invest in *any* chuck: 3- and 6-jaw GRIPTRU chucks, 4″ to 12″ diameter . . . 3- and 4-jaw Universal chucks, 4″ to 24″ diameter . . . 4-jaw Independent chucks, 3¼″ to 28″ diameter. All are outstanding values. See your dealer, or write for descriptive literature today.

351

BURNERD CHUCKS

CLAUSING DIVISION
ATLAS PRESS COMPANY
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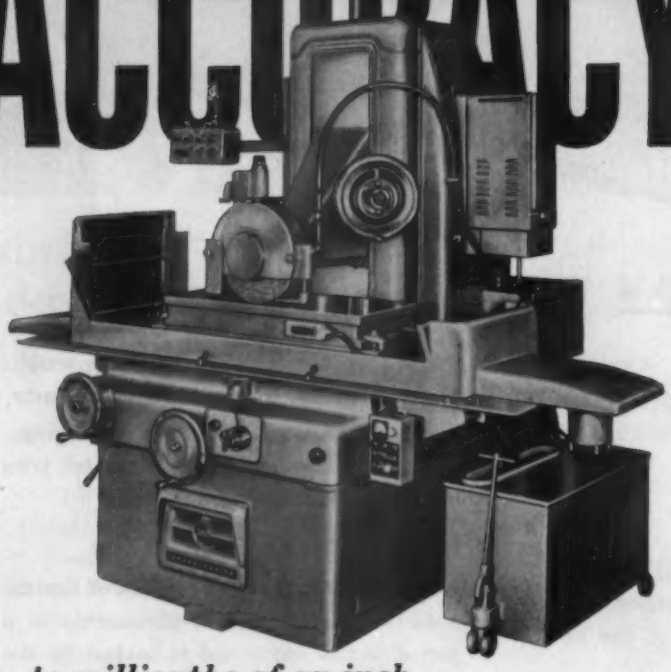
ACCURACY ACCURACY ACCURACY



. . . to millionths of an inch

Accuracy that's a must for tool rooms . . . so fine it can be measured only by a light bounce, so precise it produces micro-inch finishes at production speeds. This is the accuracy you get in the No. 560 Grand Rapids Precision Tool Room Type Hydraulic Feed Surface Grinder . . . accuracy assured by such features as hand-scraped V-shaped ways, rigid one-piece column and base casting, truly automatic cross feed and extra-heavy spindle. Why settle for less?

For information on the No. 560 or the Nos. 550, 360 and 350 Tool Room Type Surface Grinders, send a note on your letterhead.

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39 DUCTILE IRON — *Brillion Iron Works Inc, Brillion, Wis.* 20-page bulletin 131-B discusses features; types; relationship between tensile strength and hardness; effects of heat treatment and alloying elements.

40 GENERAL PLATE PRODUCTS — *Texas Instruments Inc, Metals & Controls Division, 34 Forest St, Attleboro, Mass.* 14-page revised brochure, fourth edition, covers line which includes solid and clad base metals, solid and clad precious metals, thermostat metals, electrical contacts, and the company's industrial metals: manganese age-hardening alloys, cored and clad wires, thin gage metals, solid and clad resetor metals, clad metals for semiconductor applications, and aluminum-iron alloys.

41 DRIVE EQUIPMENT FOR PLANERS—*General Electric Co, Schenectady 5, NY.* 4-page booklet GEA-7147 provides information on dc adjustable-voltage drive equipment. Illustrates complete line of all-electric adjustable speed drives for modern reversing-motor planers. Describes Kinamatic dc drive motors with low armature inertia and high transient commutating ability for rapid reversals and fast response.

42 HYDRAULIC PRODUCTS—*Vickers Inc, Division of Sperry Rand Corp, Detroit 32, Mich.* 74-page catalog 5001C covers complete line for the industrial, marine, and ordnance fields. Includes power packages, servo valves and systems, vane pumps, piston pumps, pressure controls, flow controls, directional controls, control assemblies, hydraulic motors, variable speed drives, hydraulic cylinders, and accessories. Photos, drawings, tables, curves, and typical circuit diagrams included.

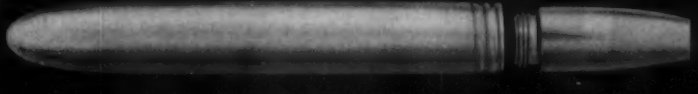
43 BALL BEARING UNITS—*Sealmaster Bearing Division, Stephens-Adamson Manufacturing Co, Ridgeway Ave, Aurora, Ill.* Catalog 454 on complete line provides technical and engineering data, specifications, diagrams, illustrations, and typical applications. Features include permanent seal, pre-lubrication, self-aligning, and zone hardening.

44 STEEL PLATE AND SHEET — *Youngstown Sheet & Tube Co, Youngstown, Ohio.* 4-page brochure describes special features of Yoloy E, a low alloy high tensile steel that combines corrosion resistance, high strength, and light weight with easy welding and fabricating. Applications listed, plus a chart showing fabrication practice for cold forming.

"Is that your darn fool machine sticking way out in the aisle?"

On screw machine products

Alcoa puts the metal where you want it



Flo-Master Felt Tip Marking Pen made in clear, black and seven other Alumilite* finishes by Alcoa for Cushman & Denison, Camden 1, N. J., a subsidiary of The Esterbrook Pen Company.

*Trade Name of Aluminum Company of America

Alcoa's wizardry in machining aluminum and its alloys lets you write your own ticket for designing screw machine parts.

The Flo-Master Felt Tip Pen is just such a job. Its four pieces require 45 machining operations, 43 of which most machine shops could handle without blinking. But the two deep drillings of the 2½-in. cap and the 3½-in. barrel demand the special skills of extremely knowing hands—hands like those at Alcoa's shop in Lancaster, Pa. These adept hands also use eight different finishing operations to attain a colorful final finish that is highly attractive—unaffected by inks or ink solvents—*and economical.*

Whether it's screw machine products, forgings, castings, extrusions or impacts, Alcoa can put the metal where you want it—precisely and economically. The payoff may be fewer rejects, new flexibility in design, less waste in production, a best-selling product—or all four. To draw on Alcoa's file of ideas and Alcoa facilities, write today: Aluminum Company of America, 911-K Alcoa Building, Pittsburgh 19, Pa.

Alcoa puts metal where you want it—in screw machine parts, castings, forgings, impacts and extrusions.

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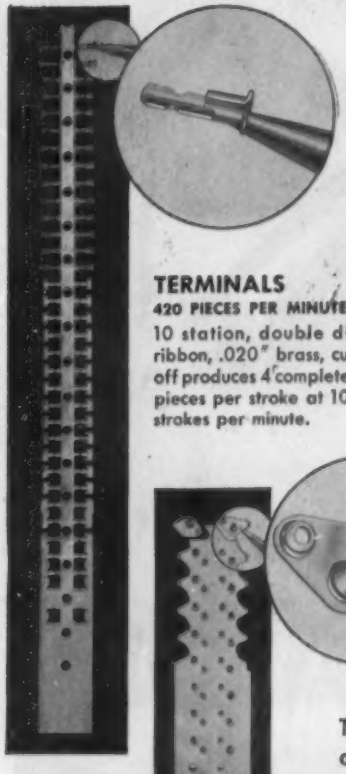
ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Precision ELECTRICAL and ELECTRONIC COMPONENTS by the MILLIONS... with



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PROGRESSIVE DIES

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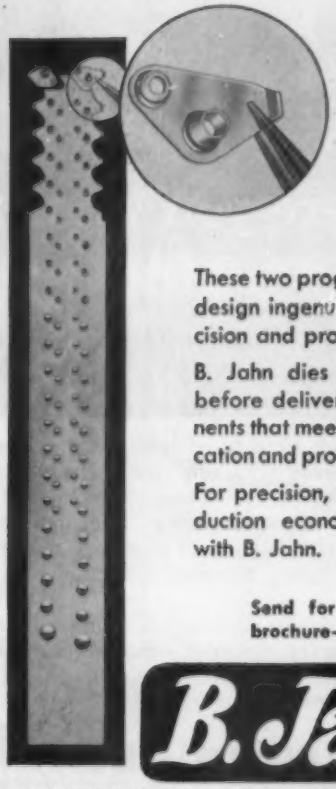
420 PIECES PER MINUTE
10 station, double die ribbon, .020" brass, cut-off produces 4 completed pieces per stroke at 105 strokes per minute.



TERMINALS
200 PIECES PER MINUTE
15 station die ribbon, .032" brass, cut-off produces 2 pieces per stroke at 100 strokes per minute.

These two progressive die ribbons show design ingenuity that pays off in precision and production.

B. Jahn dies are Production Proved before delivery guaranteeing components that meet every assembly specification and product quality requirement.

For precision, ingenuity and mass production economy—produce the best with B. Jahn.

Send for B. Jahn "Case History" brochure—no obligation, of course.

B. Jahn

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

LETTERS...

(Continued from page 76)

(Of course this was long ago, and Directors and Managers of German armament firms don't look like that today; they look like sweety-pies and are going to do good.)

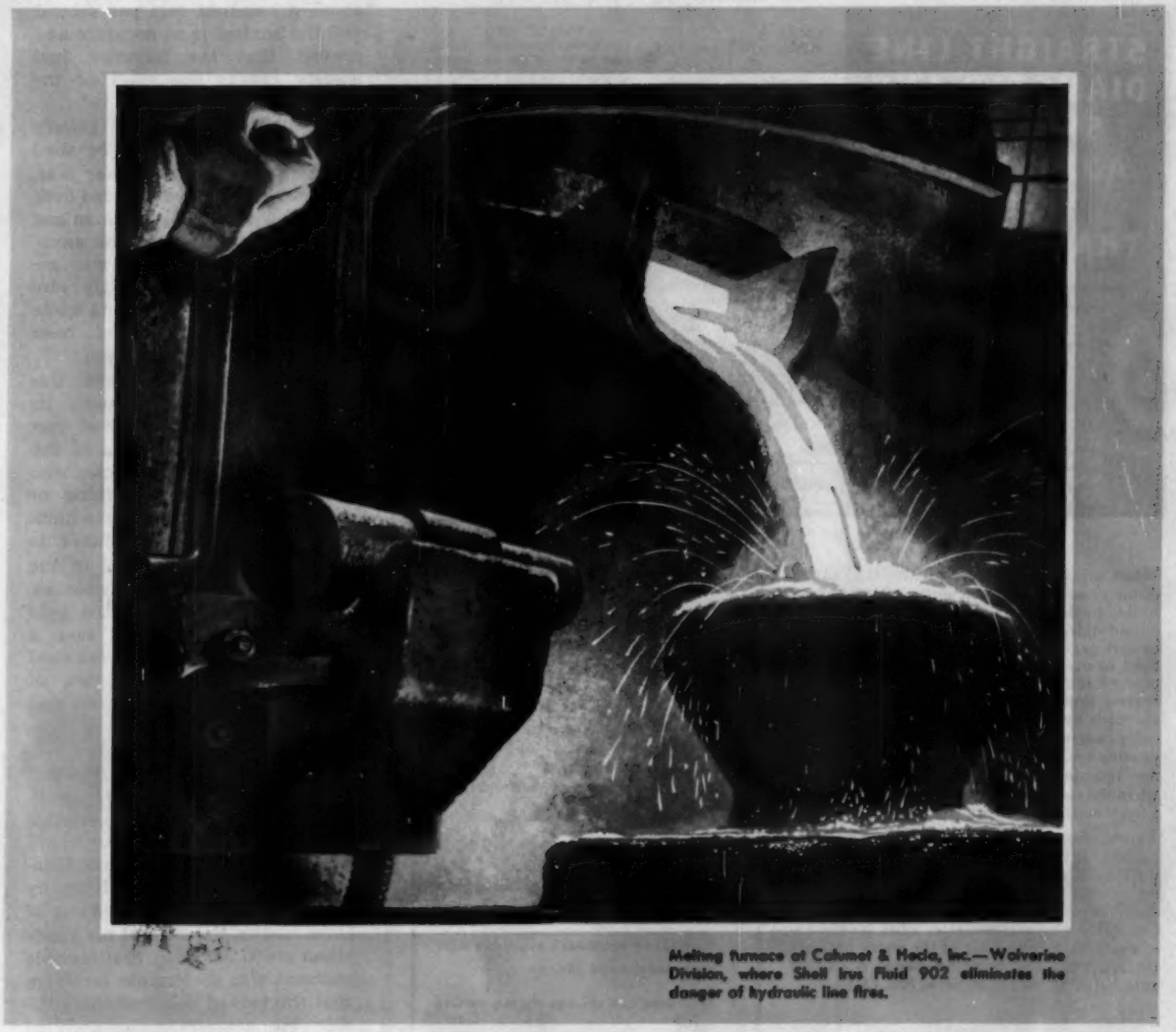
It was good lunch—if you don't mind eating within sight of portraits of two Kaisers Wilhelm and a lot of Krupps von Bohlen und Halsbach, and other people about whom everyone says after every war, 'They're for it,' but they're not, and in the end they get all their money back and are sweety-pies.

After lunch they said well now we would go and see the works. I thought it was going rather far to eat their good lunch and not tell the important thing I felt they ought to know, so I said, by way of leading up to the subject, that I was 'rather bad with machinery.'

When they seemed not to care —probably taking me for some sort of pseudo-duffer, very English characteristic—I went farther and explained that not only am I 'not good' with machinery in the sense that I can't make it work, but I actually break it: it comes apart not simply in my hand but whenever I am anywhere near it. I could have gone on to give them numerous instances — roads and lakes littered with broken motor-cars and motor-boats, and those awful periods stuck in lifts—but they were arrogant, impatient people and they made the arrogant, impatient error of dismissing what I said as being some kind of Anglo-English whimsy. Hubris is the word for what they had, like people in a Greek tragedy, and, as in Greek tragedy, it laid them low.

One of them, who had at least been listening to me, waved his hand and said that as for breaking the Krupp Works, did I realize, ha-ha-ha! that they extended over an area of twenty square miles, or whatever the area was?

The first place we went to was the place where they had their newest, biggest, electric hammer, and I knew they were going to do that corny old trick that people with electric hammers always do when people without electric hammers come to call. The man takes a gold watch and puts it on the great steel anvil, and then this enormous great steel column—the hammer — weighing so-and-so many tons, comes whizzing down



Melting furnace at Calumet & Hecla, Inc.—Wolverine Division, where Shell Irus Fluid 902 eliminates the danger of hydraulic line fires.

Ready... aim... NO FIRE!

Take 10 high-temperature alloy-melting furnaces, hydraulically operated—each pouring 1500 lbs. of molten metal every hour in close proximity to "live" hydraulic lines—and you can readily see why selection of hydraulic fluids is important to Calumet & Hecla's Wolverine Tube Division.

Now the operation is made more reliable by the use of Shell Irus Fluid 902, a water-in-oil emulsion type fluid. Irus® Fluid was C & H's choice, after carefully studying other commercial hydraulic fluids—for many reasons:

1. Irus Fluid will not support combustion.
2. Irus Fluid has excellent lubricating properties.
3. Irus Fluid has hydraulic efficiency and equipment compatibility.
4. Irus Fluid is economical, costing about one-third less than other fire-resistant fluids.
5. Irus Fluid's bright yellow color makes it easy to spot and trace leaks.

In plant after plant, operators find that these advantages assure maximum safety to both personnel and equipment

If you have a hydraulic line fire hazard, we suggest that you have the Shell Industrial Products Representative show you the many advantages in Irus Fluid 902; or write to Shell Oil Company, 50 W. 50th St., New York 20, N. Y., or 100 Bush St., San Francisco 6, Calif. In Canada: Shell Oil Company of Canada, Ltd., 505 University Ave., Toronto 2, Ontario.

AN INTERESTING FACT!
Every Shell Branded Industrial Lubricant is named for a sea shell. Shown here is the Irus elliptieus.

SHELL IRUS FLUID 902

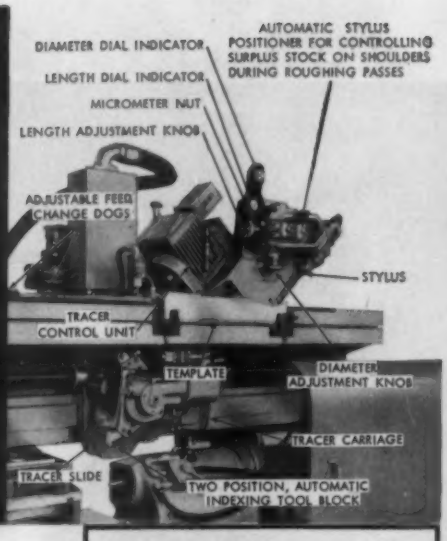
the low-cost, fire-resistant hydraulic fluid

SHELL

STRAIGHT LINE DIAMETER AND SHOULDER ADJUSTMENT FOR TRACER TOOLS

STYLUS DIAMETER ADJUSTMENT IS MADE ON 90° ANGLE TO CENTER LINE

STYLUS LENGTH ADJUSTMENT IS MADE PARALLEL TO CENTER LINE



When using the Seneca Falls Model Q Lathe, diameter and shoulder length accuracy is controlled by the stylus which is adjusted on compound slides whose displacements are indicated by dial gages. Slide adjustment knobs are rotated so that dials indicate the desired amount of stock removal, after which they are again set at zero. Both diametral and length adjustments are made by the "straight line" method...each independent of the other. The dial gages also provide visual indication of tool wear and permit resetting of the stylus to zero position when the tool insert is indexed or changed for a fresh cutting edge.

Another feature of this stylus adjusting mechanism is that the amount of surplus stock left on the shoulders during the roughing passes may be automatically controlled. The illustration shows the micrometer nut which may be preset for limiting surplus shoulder stock on the finishing pass. The shifting of the stylus between the roughing and finishing passes is entirely automatic. Write for Bulletin No. Q-59.

model Q tracer lathe features

- Numerical control simplifies change-over.
- Multiple tools rough and tracer tools finish turn in one automatic cycle.
- Mechanical feed to all carriages.
- Templates clear of chip area.
- Easy to load and unload.
- Straight line diameter adjustment for tracer tools.
- Four speed headstock available with automatic speed change.
- Feed rate can change during cutting cycle.

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SENECA FALLS, MACHINE CO.
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CIRCLE 314 READER SERVICE CARD

DO YOU HAVE THE ENGINEER'S GUIDE TO BLIND RIVETING PRACTICES?

Installed cost of a blind rivet is ofttimes lower than over fastening devices. Here is a 8-page analysis and compendium of blind riveting practices and applications. The reprint is priced at 35¢ and may be secured from

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about a hundred feet per second and the control is so accurate and perfect that the hammer just merely cracks the glass of the watch and then stops.

We all stood on a steel gallery that ran ronnd the hall or shed where this Krupp hammer was, and one of the wolves handed over his gold watch to the foreman and the foreman put it on the anvil. Of course I knew what was going to happen, but nobody else did, and they were looking quite bored because they had been through this routine so often.

So there was the hammer, this shining steel column, with its nether end about a hundred feet above the anvil, and one of the hogs signalled to the foreman, who pressed or pulled something or other, and the hammer came hurtling down and what it didn't do when it got to the glass of the watch was stop, not by any means. It not only pulverized that gold watch but hit the anvil such a smack that it split that great steel slab into three pieces, two of which shot across the shed and nearly killed a couple of proletarians.

Of many remarkable sights witnessed before and since, I sometimes think the most remarkable was the sight of the faces of all those Krupp Directors and Managers at that moment. I distinctly saw the blueish hair which one of them had on the back of his hands stand erect. And that first terrible moment was so terrible for them that the two of them standing beside me actually took, each of them, a half step away. Then, when normal consciousness returned, each of them, very carefully, took that half step back, towards me, again; and what each had very evidently said to himself was that to take a step away like that was an admission that he actually believed that I really did have some occult power which could make their lovely hammer, their scientifically guaranteed hammer go most awfully wrong.

And this was only the beginning of a horrible dilemma for the men of Krupp.

Because, look; Suppose we carry on with the tour, and we go right round the works, and the hammers all break, and the smelters cease smelting and melt, and the blast-furnaces won't blast, blast them. Pretty nice report that would be to make to Herr Krupp von Bohlen und Halsbach.

Well, ye-es, but say we cancel the tour, tell this man from *The*

Dollar for dollar, feature for feature, these are the finest inclinables you can buy.

The new Bliss "C" Series are the strongest, most advanced inclinable presses ever developed. They offer you less frame deflection . . . more die space . . . larger bed and frame openings . . . heavier crankshafts . . . than ever before. Other key features include: semi- or fully automatic oil lubrication, your choice of mechanical or air clutches, bronze ball seats and lamina bronze gibs. All "C" presses come in either geared or non-geared designs, in tonnages from 22 to 60, inclusive. Write us today for your free copy of the new catalog, illustrated in full color.

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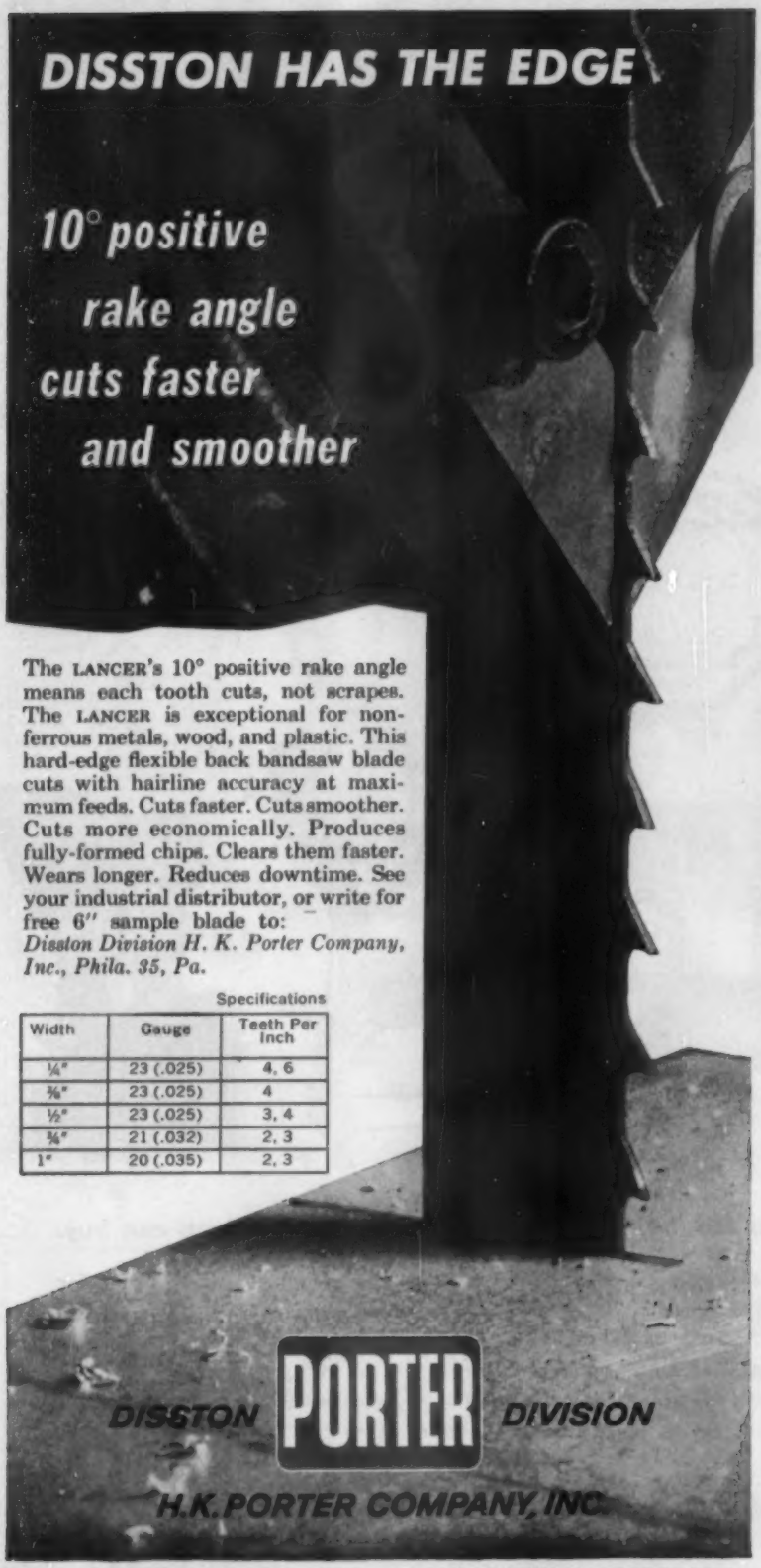
CIRCLE 320 READER SERVICE CARD



The LANCER's 10° positive rake angle means each tooth cuts, not scrapes. The LANCER is exceptional for non-ferrous metals, wood, and plastic. This hard-edge flexible back bandsaw blade cuts with hairline accuracy at maximum feeds. Cuts faster. Cuts smoother. Cuts more economically. Produces fully-formed chips. Clears them faster. Wears longer. Reduces downtime. See your industrial distributor, or write for free 6" sample blade to:
Disston Division H. K. Porter Company, Inc., Phila. 35, Pa.

Specifications

Width	Gauge	Teeth Per Inch
¼"	23 (.025)	4, 6
⅜"	23 (.025)	4
½"	23 (.025)	3, 4
¾"	21 (.032)	2, 3
1"	20 (.035)	2, 3

PORTER SERVES INDUSTRY with steel, rubber and friction products, asbestos textiles, high voltage electrical equipment, electrical wire and cable, wiring systems, motors, fans, blowers, specialty alloys, paints, refractories, tools, forgings and pipe fittings, roll formings and stampings, wire rope and strand.

Times we don't propose to show him anything at all. No peace-guns, no love-tanks, nothing. So why have we cancelled the tour? Because, my dear vulpine friend, because, mein lieber Hog, we believe—zum Teufel kreuzwarts nochmal—that this verfluchter S.O.B. really does have occult powers capable of destroying die Werke Krupp. We, Directors and Managers of the Krupp works, believe that kind of thing. We think poltergeists are true. And probably we do our export business—for instance, that little item we sent to Turkey—on the basis of communications from the ouija board.

Will that be a nice, confidence-inspiring thing to report to Herr Krupp von Bohlen und Halsbach?

You imagine it's pure joy to see a lot of Krupp men in a dizzy ten years or so before they drop a bit of their stuff on your aunt in South London. But it wasn't really—it was unnerving to see people so utterly confounded and taken aback. And this is where I am going to be accused of weakness, possibly even treachery.

I said the episode had made me feel faint and I thought the best thing to do would be to go back to Berlin and write a thoughtful piece for the *London Times*.

They said they were very, very sorry to have me leave them so soon and a fast Mercedes-Benz would be at the door in rather less than a minute and a half.

"I know you get discouraged at times dear, but remember—it's a living."

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Maintenance
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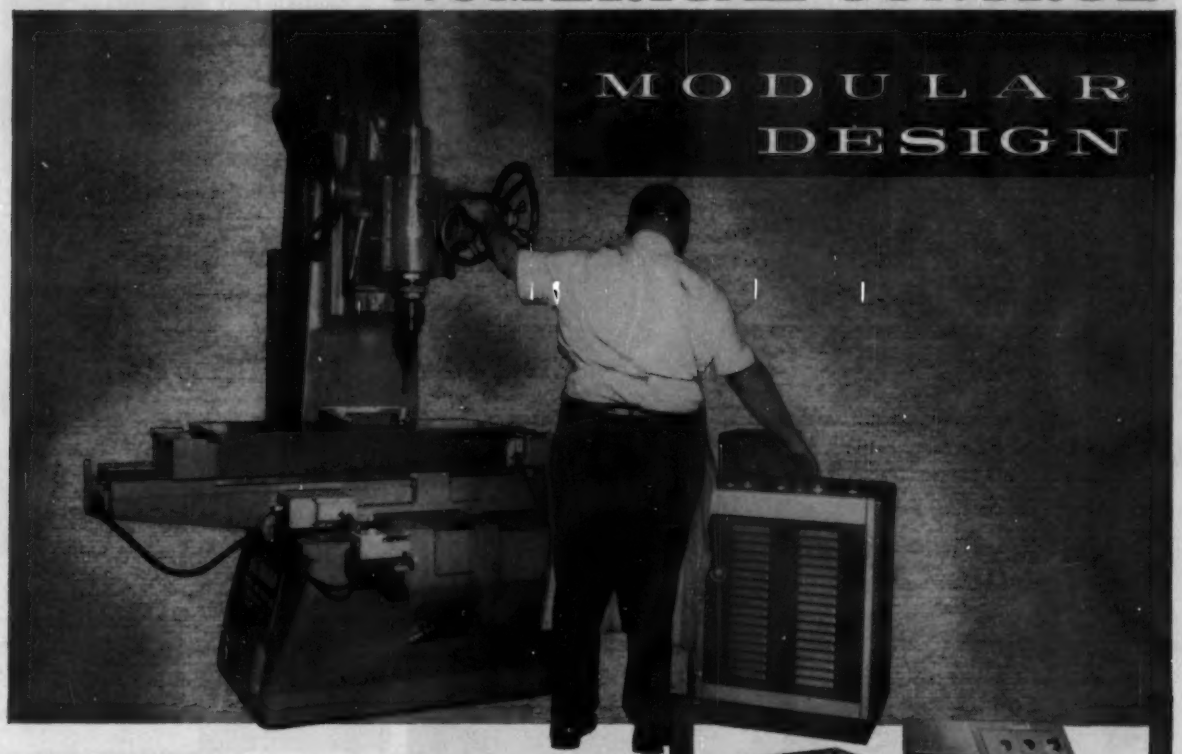
Downtime
WITH

SINGER*

NUMERICAL CONTROL

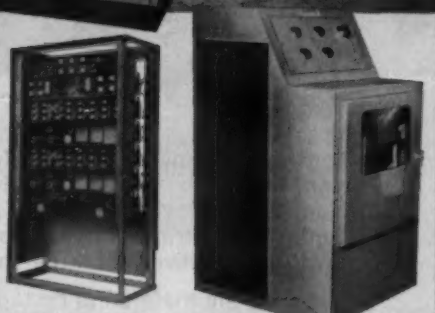


Because of the simplicity of modular design, all components within the Singer Numerical Control can be quickly and easily removed, replaced or modified.

Modular design is not the only outstanding feature of Singer Numerical Control. The high degree of accuracy is made possible by a division of the measuring section and the motor drive within the system. Accuracy of ± .001 inches on a work table with as much as 40 inches motion is another . . . increased accuracies up to ± .0002 inches are available with further refinement of the system, where compatible with the machine tool.

Singer Numerical Control Modular Design represents the most straight-forward approach to point-to-point positioning yet conceived. It offers the simplicity, reliability and economy necessary for the efficient operation of machinery.

You are invited to visit the demonstration room at Diehl Manufacturing Company's Finderne, New Jersey plant to see the Singer Numerical Control in operation and to examine actual production records. Write for the Singer Numerical Control Brochure.



Module Rack (left) contains seven easily-removed modules—the basic components of the Singer Numerical Control System—and is housed within the main Control Console. Separate modules are easily accessible and the entire Module Rack may be rolled out from the Console on the self-contained tracks. Two types of Console Cabinet are available: the smaller NEMA 1 Cabinet (at operator's hand above) and NEMA 12 Cabinet (to right of Module Rack).

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NEW FILMS...

VACUUM POURING FOR BETTER FORGINGS. *Produced by Bethlehem Steel Co, Bethlehem, Pa. 16 mm, sound, color. Running time 15 min. No charge.*

By the use of live and animated action, each successive step in the vacuum pouring process, from preparation of the equipment to pouring a multiple-heat ingot is described. A high-speed television camera was employed to look inside the vacuum chamber to show the molten stream of metal exploding into tiny droplets to release the trapped hydrogen.

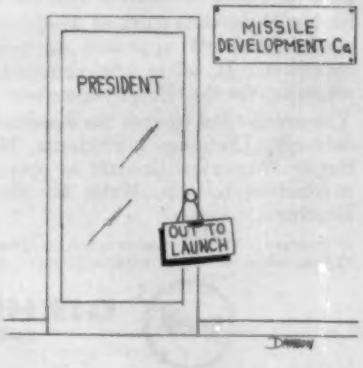
Because of the demand for high-quality steel with high mechanical properties, particularly for highly stressed forgings, vacuum-poured ingots have been made in weights as high as 500,000 lb. HEL

SERVICING THE CLARK HYDRATORK. *Produced by Industrial Truck Div, Clark Equipment Co, Battle Creek, Mich. Slide film. Running time 43 min. No charge.*

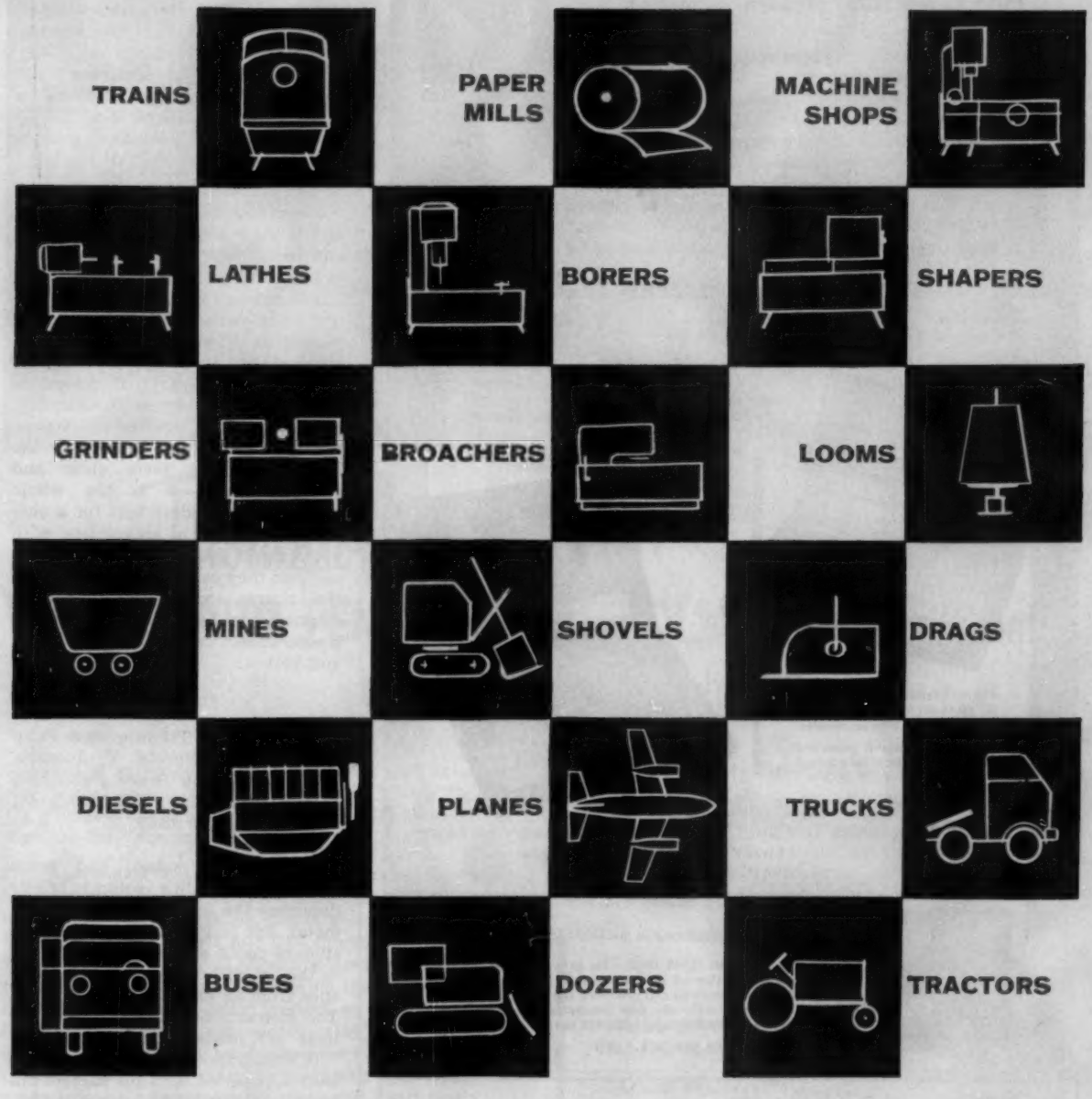
Designed to assist users in keeping their fork trucks in top operating condition, this film describes how the power-shifted transmission works, and shows how to trouble-shoot causes of malfunction.

THE ALL NEW GAS CLARKLIFT. *Produced by Clark Equipt Co, Industrial Truck Div, Battle Creek, Mich. Slide film, sound, color. Running time 20 min. No charge.*

This new film strip illustrates important design features of the Clarklift line of fork trucks, and points out the benefits of these features to users. Some of the points covered include fast lifting speeds, easy service accessibility, and maximum maneuverability.



If you manage or operate any of these...



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"I" Inspection Accuracy: +.000004"/−.000000"
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Above: Ellstrom Rectangular Set No. 92-R. Right: Ellstrom Square Set No. 81-SA, with accessories.

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WHAT HAPPENS WHEN YOU CUT METAL FASTER THAN 100,00 SFPM?

The complete story is told in a 16-page reprint from the Feb. 22, 1960 issue of AM/MM that covers Lockheed Aircraft's basic research for the Air Force on ultra-highspeed machining. Copies of this valuable report are available for 35¢ (lower in bulk quantities) from

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NEW BOOKS...

BASIC GRAPHICAL KINEMATICS—*By Harold B Kepler, assistant professor of mechanical engineering, Air Force Institute of Technology, Wright-Paterson Air Force Base, Ohio. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36. 314 pages. Price $6.00*

Mechanics is a division of physics and is the study of masses, motions, and forces. Mechanics has two divisions: statics which deals with forces acting on bodies at rest, and dynamics—which deals with bodies in motion. Kinematics, in turn, is a division of dynamics, and is the study of motion without regard to the forces that cause it. Kinetics, another division, studies the forces.

These definitions are from the book, and they seem clear and straightforward—as is the whole book. It is a standard text for a one-semester course in kinematics, with vectors and their equations taken up early so they can be applied through the course, and with the usual emphasis on basic motion, velocity, acceleration, centros, cams, gears, and belts.

•

METAL SPINNING TECHNIQUES & PROJECTS. *By Harold V Johnson. Published by Bruce Publishing Co, Milwaukee, Wis. 130 p 6¼ x 9½. Price $3.50.*

Intended for school and home workshop use, this volume briefly describes the techniques of spinning metal, but it is doubtful whether a student could attain any proficiency in the art without considerable guidance from an experienced instructor. The instructions are scanty and the tools are inadequately described.

It would appear that the author is well acquainted with his subject but lacks experience in putting the information into writing. The style is jerky, almost telegraphic, and there is too much reliance on illustrations which carry mere labels, rather than give information. Several pages are devoted to soldering and finishing, others to examples of large industrial spinning projects.

The remainder of the book, some 60 pages, is excellent, giving details of spinning projects graduated from a simple pie plate to a variety of lamps. These are carefully dimensioned, with bills of material and manufacturing steps. HEL

Thompson's exclusive "CYBERMATIC PENDANT CONTROL" completely eliminates the elevating hand wheel

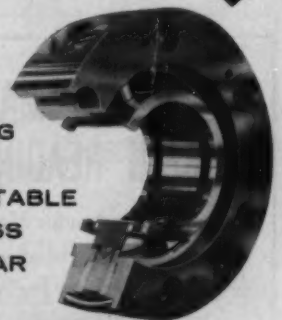
All vertical movement of the wheel head, both automatic and manual, on this modern Thompson 36 x 48 x 72 Type CX Plunge-Matic Grinder is accomplished effortlessly by dials on the Cybermatic Pendant Control.

This new pendant control performs the following functions: **Sets automatic down feed from .0002" to .006" in .0002" increments—sets the total amount of automatic down feed for stock removal from 0 to 1 inch through the entire 48" vertical capacity—controls automatic down feed increment (as pre-selected) at each reversal of the wheel head on cross feed or at each table reversal on straight plunge feed — controls a 20" per minute rapid traverse to the elevation of the wheel head—provides a push button to re-set the down feed range at operator's will — pre-sets a wheel dressing increment for automatic wheel trueing—compensates manually or automatically for wheel dressing —provides a master stop button for all movement.**

This Thompson machine is completely modern in every respect. Its features include the exclusive Thompson Hydra-Cool Hydraulic System with dual packless cylinders providing automatic cushioning. A separate automatic lubrication system for all sliding way bearings and tape bed way covers are standard equipment.

This modern Thompson grinder is both high powered and extremely accurate.

Further specifications will be furnished upon request.



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Thompson has taken another important step toward the ultimate in accuracy and precision by obtaining the exclusive use of the world famous MALCUS BLOCK BEARINGS for their wheel head spindles. The notable advantages of these bearings are listed above.

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More power at the cutters

The completely new GREAVES No. 2-XH Milling Machine brings added versatility, increased operational ease, and more power where it's needed most . . . *at the cutter!* It utilizes two motors, one for spindle drive; a separate motor for moving table, saddle and knee. Compare this and the other outstanding features of the new Greaves Mill. You'll see why Greaves is "The MOST Mill for the LEAST Money."

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- New 7½ HP spindle drive motor, with separate motor for movable components, provides extra power for heavy milling.
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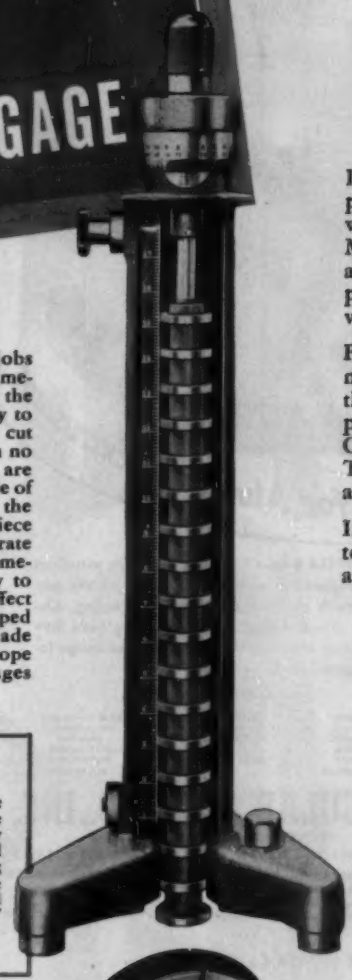
In thousands of installations on innumerable jobs PLA-CHEK Gages are daily proving their time-saving and money-saving advantages, both at the surface plate and the machine. Extremely easy to operate—and fast, too,—PLA-CHEK Gages cut inspection time from minutes to seconds with no loss of accuracy. No auxiliary gage blocks are necessary. PLA-CHEK'S measuring bar is made of deep-frozen, strain-free alloy steel. Steps on the bar are exactly 1" apart. Because of its one-piece construction, steps cannot change or separate with age. Adjustment of the bar is by the micrometer thimble at top. Since it is not necessary to touch the measuring bar, body heat cannot affect it. All reference surfaces are ground and lapped to extremely close tolerances. Precision-made risers, which give PLA-CHEK even more scope and are engineered as accurately as the gages themselves, are available for all models.



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Manufactured of the finest alloy steel, these gages are heat and cold-treated for maximum stability. They are carefully lapped and closely inspected under controlled conditions.

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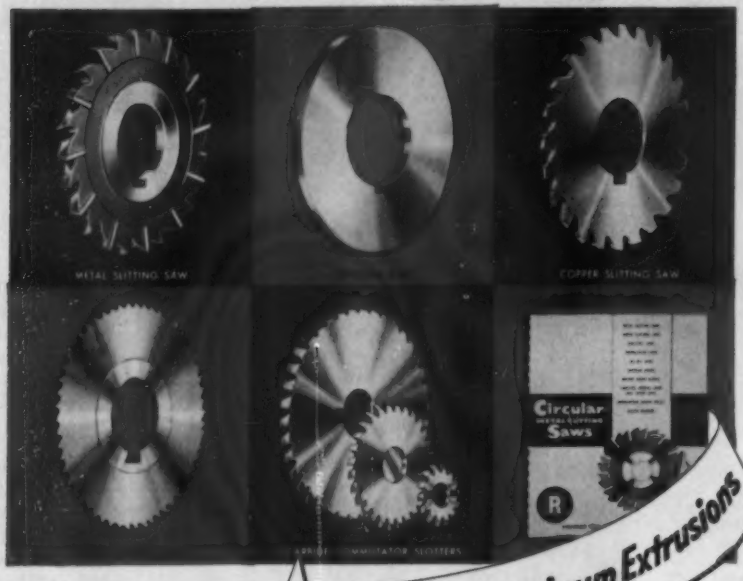
From More Than 1200 ® Catalog Items...



Saws for Aluminum Extrusions

394-9

CIRCLE R saws for cutting aluminum extrusions are designed for high efficiency, scientifically perfected with exclusive Circle R Heat Treating. Aluminum extrusion saws are listed among more than 1200 items in our catalog — and we also design for your special needs.

Consult a CIRCLE R *Specialist in . . .*

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CIRCULAR TOOL CO., INC.

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Specialists in Circular Cutting Tools Since 1923

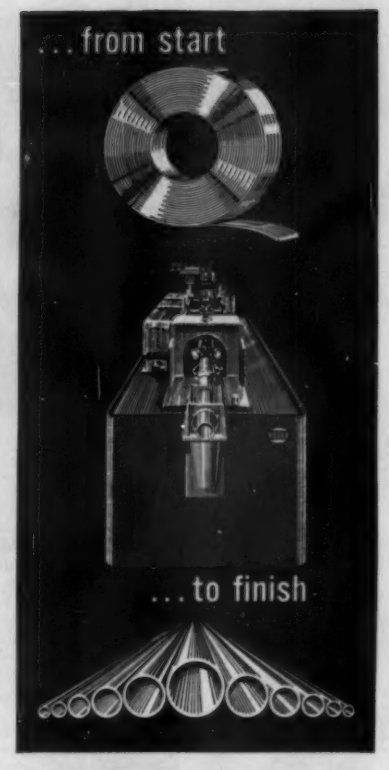
METAL SLITTING SAWS • COPPER SLITTING SAWS • SCREW SLOTTING SAWS • COMMUTATOR SLOTTING SAWS • JEWELERS' SLOTTING SAWS • CUT OFF SAWS • CIRCULAR SHEARS & ROTARY SHEAR BLADES • CIRCULAR STEEL SAWS • SOLID & TIPPED TUNGSTEN CARBIDE SAWS • COMBINED DRILLS & COUNTERSINKS • CENTER REAMERS

CIRCLE 330 READER SERVICE CARD

THE PRODUCTION MAN'S GUIDE TO JOINING WELDED STEEL TUBING

There are 116 different ways to join one piece of weld steel tubing to another. Here's a basis compendium of data on methodology for manufacturing in that covers the two basic classifications; welding and mechanical. The 16-page reprint from AM/MM is available for 35¢ from

Reader Service Department
American Machinist/Metalworking Manufacturing
330 West 42nd Street, New York 36, N. Y.



YODER PIPE & TUBE MILLS

A Yoder engineer can help you realize remarkable savings in the manufacture of ferrous or non-ferrous pipe or tube. He can show you how present Yoder Pipe or Tube Mill owners are increasing production, lowering over-all manufacturing costs and reducing downtime through use of Yoder Mills.

If your products require pipe or tubing from ¾" to 26" diameters, Yoder Pipe or Tube Mills and accessory equipment can help you produce your product more efficiently to meet today's competitive markets.

In addition to Pipe or Tube Mills, Yoder engineers and builds a complete line of Slitting equipment and Cold Roll-Forming Machinery.

For complete information on Yoder Tube Mills...send for the fully illustrated, 64 page Yoder Tube Mill book ...it is yours for the asking.

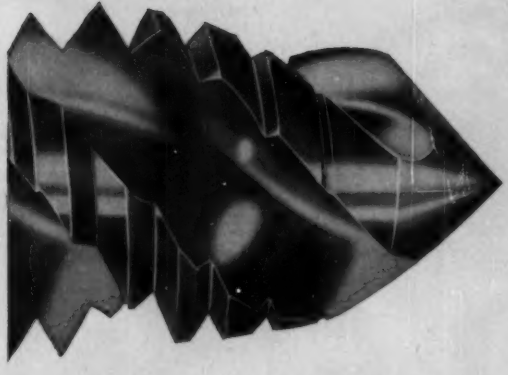
THE YODER COMPANY
5519 Walworth Avenue • Cleveland 2, Ohio

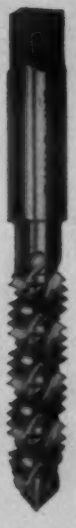
YODER PIPE AND TUBE MILLS (ferrous or non-ferrous)

CIRCLE 331 READER SERVICE CARD

BAY STATE

HY-SPIRAL TAPS





RUGGED STRENGTH . . . SHEARING CUT . . . MORE THOROUGH CHIP REMOVAL

The advantage of the spiral fluted tap is its ability . . . through the thrust back action of its helical flutes . . . to discharge the chips produced by its shearing cut.

The HY-SPIRAL tap, with its increased helix angle, provides additional shear and greater thrust back action. The result is more thorough chip removal than is obtained with conventional spiral fluted taps (25° to 30° flute angle).

The HY-SPIRAL tap is particularly adaptable for deep holes and blind holes in steel and aluminum.

For more information about HY-SPIRAL taps and for quality taps and dies, call your Bay State distributor.

On the nearby shelves of your Industrial Distributor

BAY STATE TAPS

BAY STATE TAP & DIE COMPANY · MANSFIELD, MASS.

A SUBSIDIARY OF THE CLEVELAND TWIST DRILL COMPANY

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AIR EXPRESS...
FIRST ON, FIRST OFF
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AIR EXPRESS goes where the jets go. It has ever since the first commercial jetliner roared skyward. But 600 mph speed is just one more reason progressive businesses hail AIR EXPRESS as America's modern way of doing business; there are others:

Like the sure knowledge that AIR EXPRESS gets first priority treatment on all 35 of the nation's scheduled airlines. It's always first on, first off—with new loading systems tailored to the jet age, and kid-glove handling every mile of the way.

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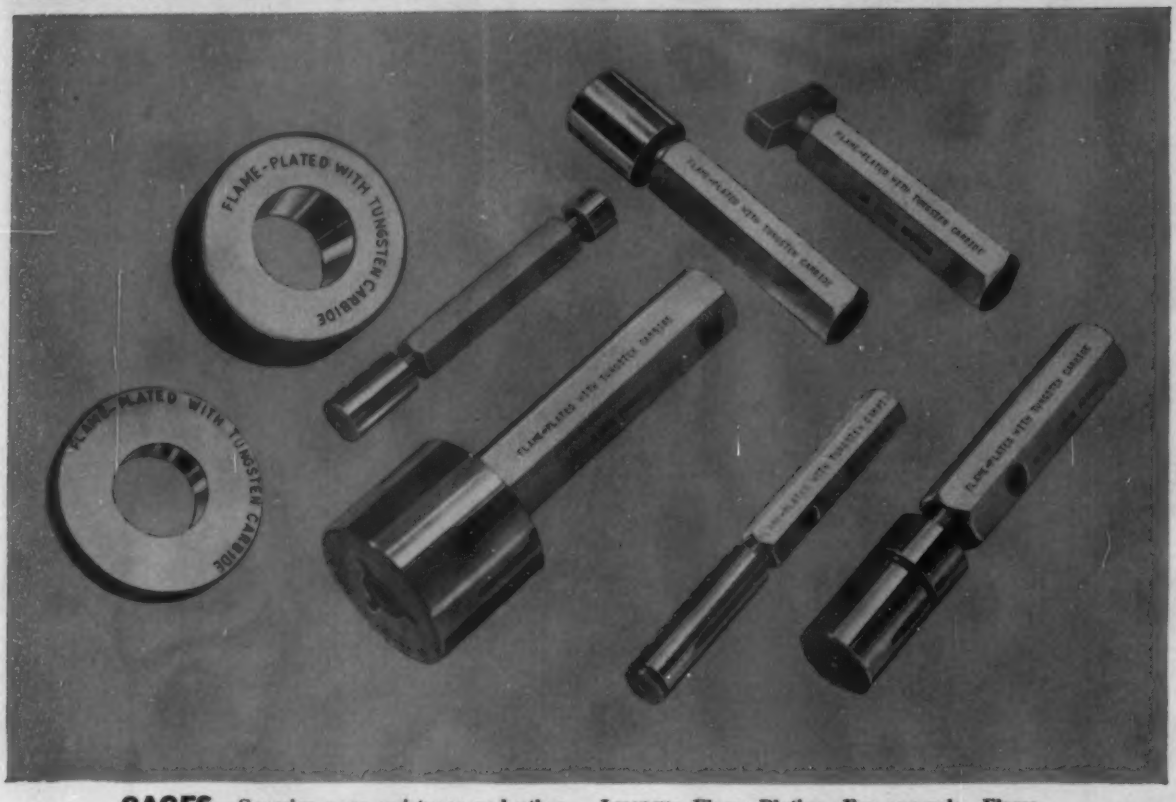
GAL. AIR EXPRESS DIVISION OF RAILWAY EXPRESS AGENCY • GETS THERE FIRST VIA U. S. SCHEDULED AIRLINES

PRECISION PARTS GET TODAY'S

LINDE's FLAME-



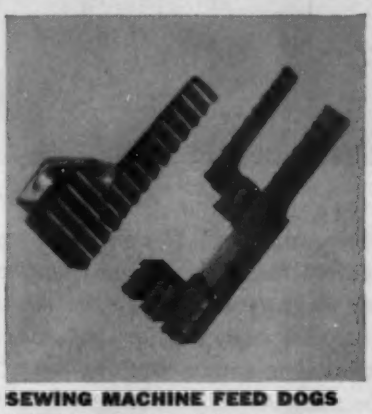
GAGES—Superior wear resistance and other unique cost-saving advantages are exhibited by plug, ring, air, and specialty gages treated by LINDE's Flame-Plating. For example, Flame-Plated plug gages outwear solid carbide plug gages 3-to-1, and hard chrome-plated gages 20-to-1.

AIRCRAFT VALVES

Bearing surfaces of hot air valves used in the bleed air system of Lockheed's F-104A Starfighter must meet extreme conditions of wear and abrasion, also conditions of high unit loading and temperature extremes. Flame-Plating these surfaces with tungsten carbide solves the problem.

ALUMINUM ROCKER ARMS

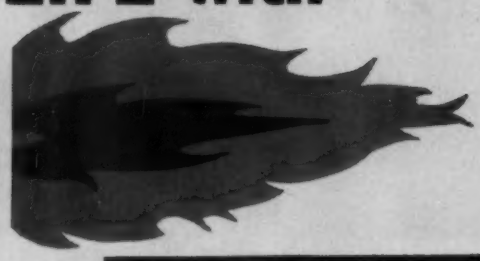
One side of the "fin" of this important item in an aircraft engine heater mechanism actuates a lever and is subjected to severe wear. Before Flame-Plating, it lasted from 100 to 300 hours. Coating the wearing surface with tungsten carbide boosted service life to more than 1000 hours.



SEWING MACHINE FEED DOGS

LINDE's Flame-Plating has increased by more than six times the service life of the movable, serrated part that pushes material through the sewing machine. In this application, a .002-in. coating of tungsten carbide in as-coated condition provides both long wear and dependable gripping.

LONGEST SERVICE LIFE with PLATING



Gages and other components achieve remarkable resistance to wear when coated with tungsten carbide and other materials by LINDE's 6,000-degree, supersonic "weld-on" process . . .

NOW—many of the profit-consuming problems of metal wear and machine down-time have been eliminated.

With LINDE's Flame-Plating, gages, spindles, bushings, seals, mandrils, dies, core rods and other precision parts and components retain their precision and close tolerances for the *longest* period of time—under the toughest conditions of abrasion, erosion, corrosion, and high-temperature wear.

LINDE's exclusive service coats base metals with particles of ultra-hard materials, such as tungsten carbide and aluminum oxide—heated to plasticity by 6,000 degrees F. inside the Flame-Plating gun and then successively "fired" at 2,500 fps at the "target area."

The result is a tenacious, "welded-on" coating of approximately 125 microinches rms, which can be finished to the desired microinches rms.

NO WARPAGE—NO METALLURGICAL CHANGES

Despite the 6,000-degree temperature within the Flame-Plating gun, the temperature of the precision part or product being coated remains below 250 degrees F. This feature eliminates distortion and changes in the properties of base metals. Other features include low coefficient of friction and porosity of less than 1 per cent.

Wherever *continuing* precision and *optimum* wear are important factors, LINDE's revolutionary Flame-Plating gives amazingly longer service life . . . reduces production rejects . . . increases salvage value.

Find out how this coating service offered by the Linde Company can save on operating costs, make a good product even better, and improve over-all reliability. LINDE will provide a complete engineering analysis. List your possible applications in the coupon on the right and mail today for complete information.

TYPICAL FLAME-PLATING APPLICATIONS

BEARINGS—sleeve, roller, gas
BLADES—aircraft turbine; doctor blades for papermaking
BLOCKS—anvil
BUSHINGS—ball piston pump
CHUCKS—seaming
CUTLERY—household
CUTTING, INDUSTRIAL—rubber, plastic, skiving knives, foods, paper, slitter knives, chipper knives, discontinuous chip-abrasive materials
DIES, TOOLING—cold-forming; coring punches, core rods, sizing punches, capstans
DOGS—sewing machine feed; gripping dogs
DRILLS—paper, acoustical tile, twist
GAGES—plug, ring, air
GUIDES—wire, textile, machine
HYDRAULICS—pistons, liners, valve plates, wobble plates, metering valves, servo valves, slippers
MANDRILS—wire-forming
PARTS—sintered
PISTON RINGS
PLATES—valve, wear
SEALS—turbine engine, pump
SURGICAL—needle holders and shears
VALVES—aircraft

AM-113

Linde Company, Flame-Plating
270 Park Avenue
New York 17, New York

I am interested in Flame-Plating for the following application(s):

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NAME_____ TITLE_____

COMPANY_____

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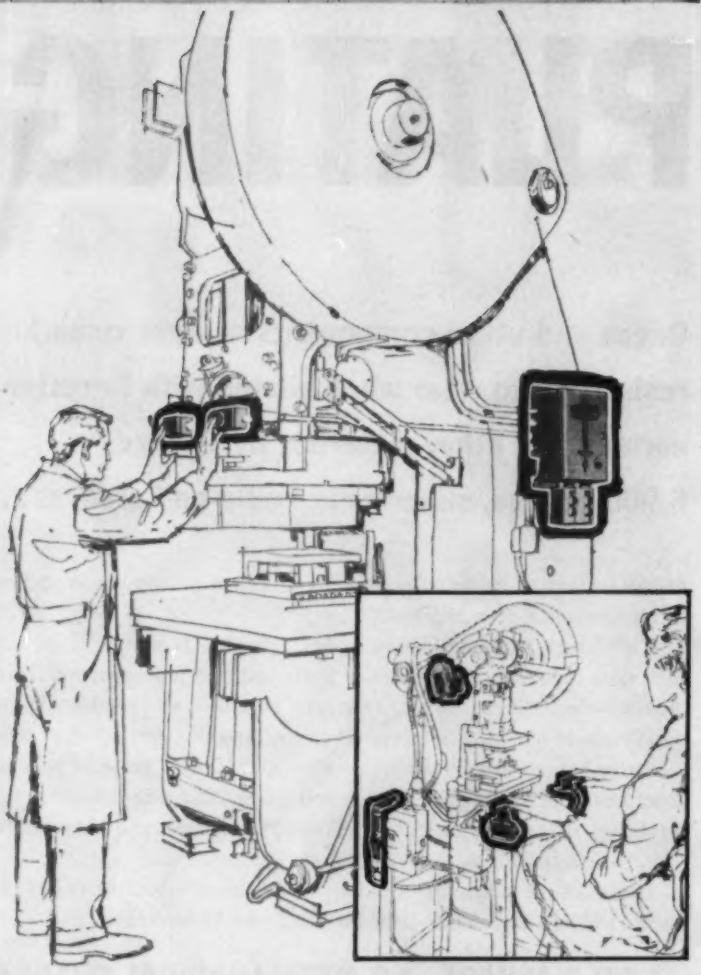
LINDE COMPANY
Division of Union Carbide Corporation

UNION CARBIDE

LINDE and UNION CARBIDE are trade-marks of Union Carbide Corporation.

MICRO SWITCH Precision Switches

Why you should not have a punch press without MICRO SWITCH TRIP CONTROL



Packaged Kits . . . Low in Cost
Trip Controls from MICRO SWITCH start as low as $60.00 and are packaged in six simple, easy-to-wire models that fit virtually any punch press or paper cutter.

1. **You can increase production.** It's a matter of dollars and cents. Productivity of small bench presses as well as large OBI's will jump when Trip Control is installed. Finger-tip actuation of precision electric switches cuts operator fatigue, keeps production up even at the end of the day. Simple, direct operating motions let the operator continue a smooth, productive work rhythm. The switch does the work, particularly important in replacing awkward or heavy lever action that causes fatigue.

2. **TRIP CONTROL can't be cheated—even for the first stroke!** An exclusive feature of the MICRO SWITCH Trip Control is the "Can't Cheat" feature. It absolutely prevents the dangerous condition of an operator tying down or wedging one switch and then operating the control with one hand. Unlike other systems, Trip Control will not allow even one stroke under these conditions. An exclusive "Fail-Safe" feature prevents an accidental actuation of the clutch due to a faulty or damaged control component. Another exclusive protects die setters and maintenance men—and expensive dies—during set-up.

Ask about actual cases where Trip Controls increased production and raised employee morale. Your nearby MICRO SWITCH *branch office is listed in the Yellow Pages. Or write for revised Catalog 65.*

MICRO SWITCH . . . FREEPORT, ILLINOIS
A division of Honeywell
In Canada: Honeywell Controls Limited, Toronto 17, Ontario

Honeywell
MICRO SWITCH Precision Switches

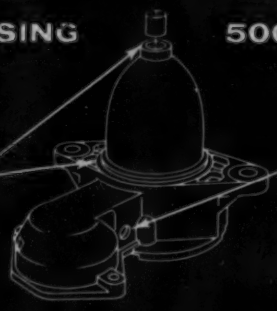
MOTOR DRIVE HOUSING — **500 PARTS PER HOUR GROSS**

THREE VERTICAL UNITS

1V COMBINATION FINISH FACE
TURN 2.75 DIAM.
ROUGH REAM .516

3V FINISH REAM FOR BUSHING

4V PRESS IN BUSHING
BURNISH BUSHING I.D.



TWO HORIZONTAL UNITS

2H DRILL

3H LINE REAM
THRU 2 WALLS

How versatile can a Kingsbury machine be?

This indexing automatic drills, reams, turns, faces — even presses and burnishes

Check the drawing against the photo and you'll see it's possible to combine a variety of operations in one Kingsbury. You get high production and you *don't* sacrifice accuracy.

How did we combine so many operations in a 26-inch four spindle machine with only six work fixtures?

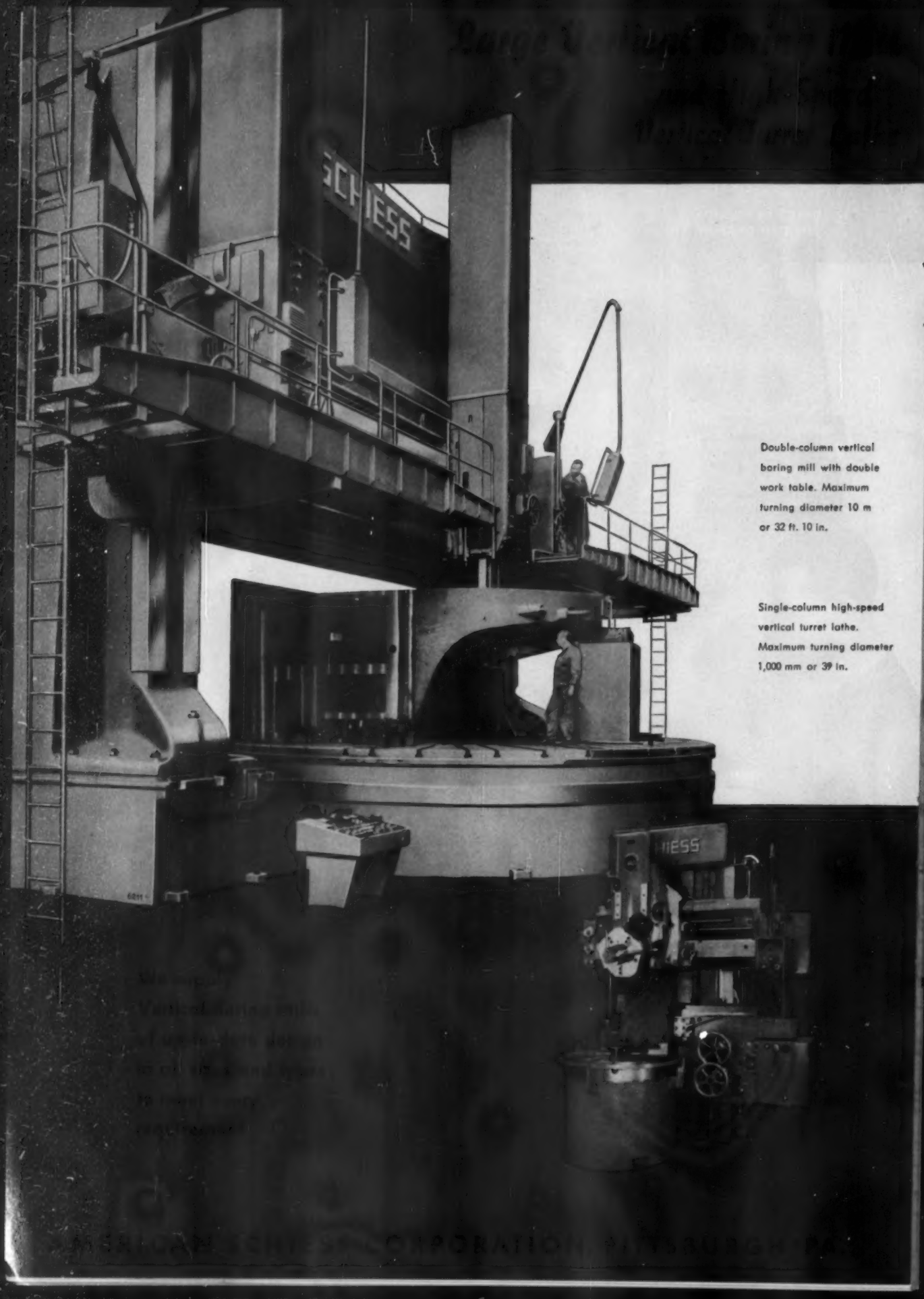
First, a special boring spindle with a large combination tool turns, finishes and faces. Slides instead of guide rods provide the rigid mounting needed for large tools working to close tolerances.

Second, the return stroke of the pin that presses in the bushing also burnishes the bushing's inside diameter.

Third, good basic design and rugged accurate construction result in the most efficient, compact setup for the job.

If you even *suspect* a Kingsbury might fit into your production, why not ask us? If we say we can do it, we can do it. Test runs before shipment guarantee each Kingsbury will produce uniform parts that gage. Kingsbury Machine Tool Corp., Keene, N. H.

KINGSBURY MULTI-UNIT AUTOMATICS



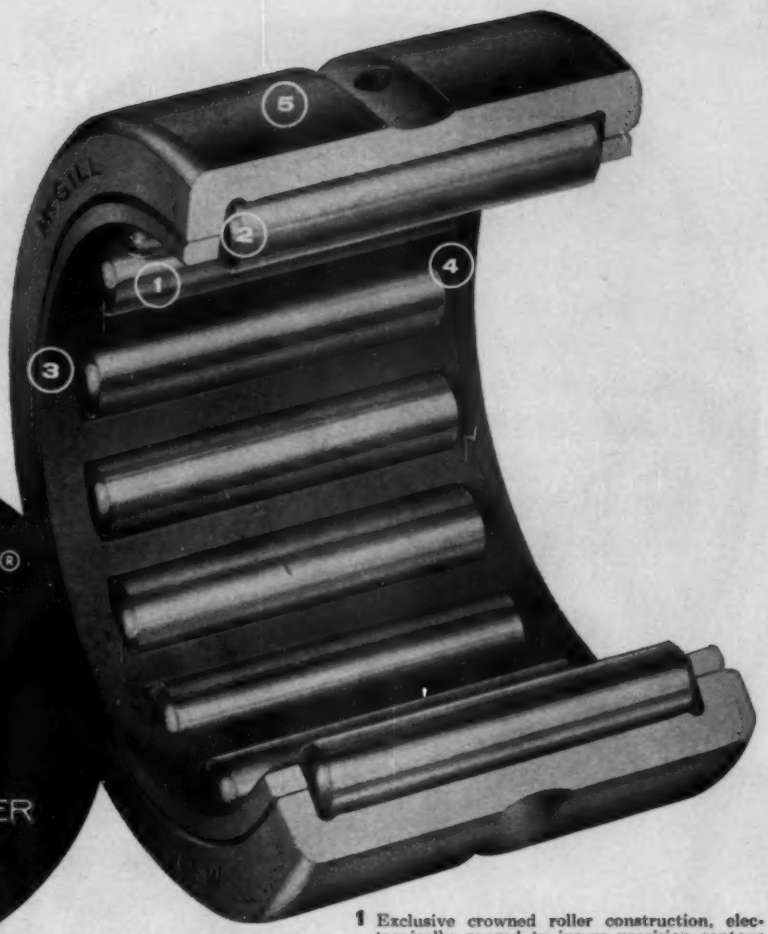
Double-column vertical boring mill with double work table. Maximum turning diameter 10 m or 32 ft. 10 in.

Single-column high-speed vertical turret lathe. Maximum turning diameter 1,000 mm or 39 in.

NEW

CAGEROL®

CAGE TYPE
HEAVY DUTY
NEEDLE ROLLER
BEARING



BY McGILL®

INCREASE EXPECTED LIFE UP TO 10 TIMES!

You need CAGEROL bearing performance if higher speeds and increased misalignment have prevented the utilization of needle bearing load capacity in your applications. Most important, CAGEROL bearings can deliver up to 10 times more expected life where misalignment and increased speeds exceed the capabilities of ordinary and guided needle bearings. The difference is in the exclusive McGill construction that features tapered retainer pockets for balanced roller guidance, crowned rollers, and black oxide retainer finish. CAGEROL bearings are interchangeable with all heavy duty needle roller bearings — with or without inners in two bore sizes.

McGILL MANUFACTURING CO., INC., Bearing Division
300 N. Lafayette Street, Valparaiso, Indiana

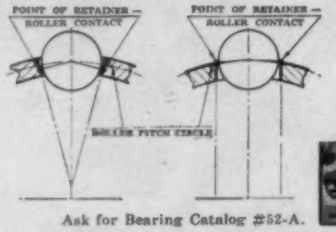
1 Exclusive crowned roller construction, electronically gauged to insure precision contour and size uniformity. Relieved ends assure even load distribution.

2 Flat ends fully engage integral race shoulders. provide maximum support.

3 Proper guidance assured by tapered retainer pockets. The design insures *balanced* roller support and eliminates corner wear from edge loading of straight pockets where retainer OD and pitch circle are coincident.

4 Simultaneously punched pockets assure accuracy of race and roller alignment. The black ferrous oxide retainer finish absorbs and retains lubrication, reducing the friction coefficient.

5 SAE 52100 steel outer race has optimum hardness and surface finish.



Ask for Bearing Catalog #52-A.

engineered electrical products

McGILL®

precision needle roller bearings

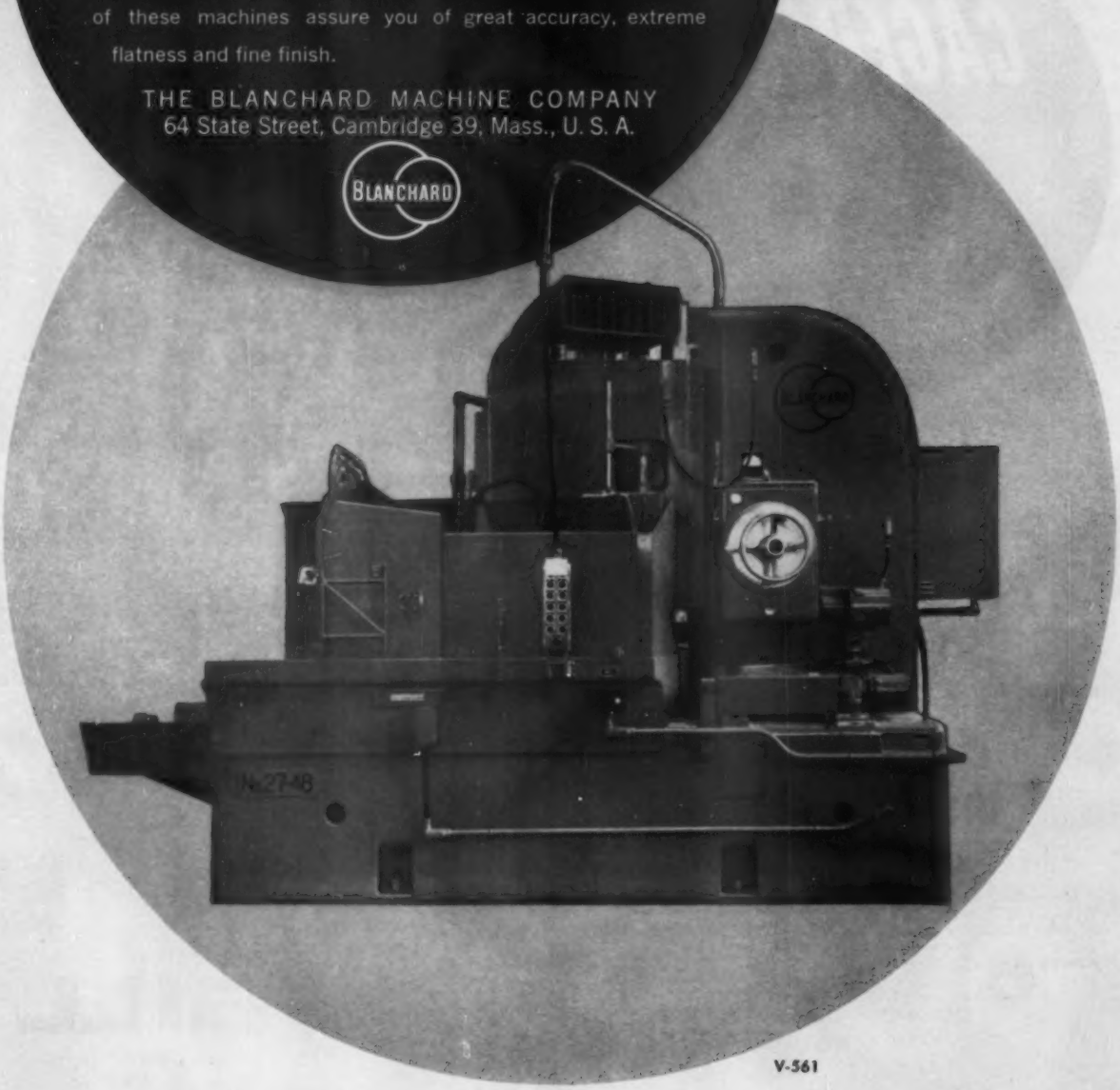
NEW

Blanchard
proudly introduces the No. 27-48
and No. 27-60 Blanchard Surface Grinders,

which offer new features and high-production capabilities that give you high-speed, precision grinding at lower-than-ever cost. These new Blanchards are of "dry base" design. All coolant and chips discharge from the grinder base. They are powered by a 60 or 75 HP main spindle motor. Coolant is directed both to the inside and outside of the grinding wheel. These features provide ample power, rigidity and coolant flow for heavy stock removal on a large variety of work pieces. The advanced design and careful construction of these machines assure you of great accuracy, extreme flatness and fine finish.

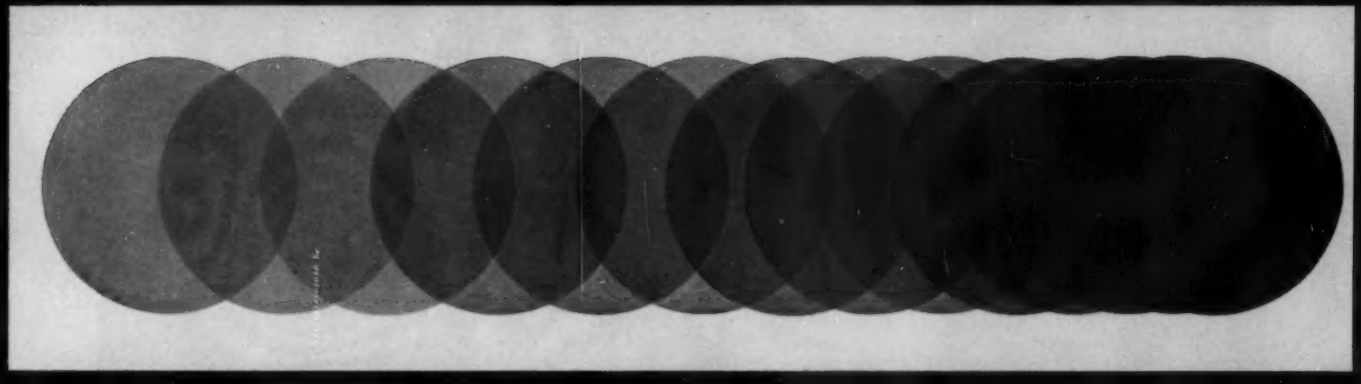
THE BLANCHARD MACHINE COMPANY
64 State Street, Cambridge 39, Mass., U. S. A.

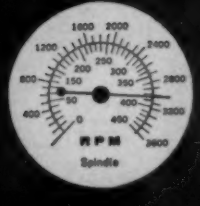
BLANCHARD

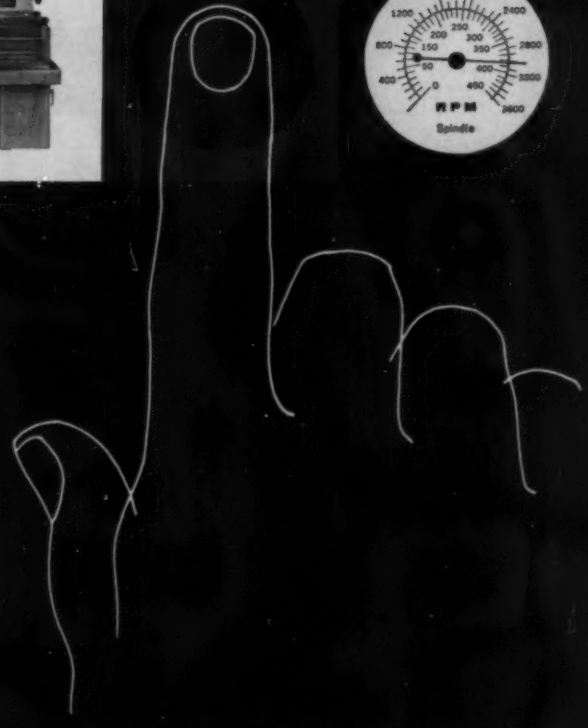


V-561

Infinitely Variable Spindle Speeds!







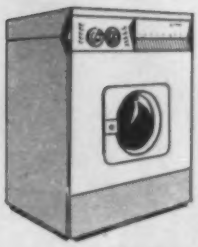
new proven design

NEBEL MICRO-TURN*

HIGH-SPEED PRECISION LATHE

Here is the ultimate in turning efficiency and convenience. Simply push a button until the spindle speed you desire indicates on the tachometer. A continuously variable range of spindle speeds from 43 to 3500 RPM is provided by a highly efficient, proven mechanical speed variator belt-less type drive unit . . . with full motor horsepower (3 or 5 HP) throughout the entire range and speed constant within .2%. But this is just one of the revolutionary features of the Nebel MICRO-TURN. Write today for your copy of the complete story on the new MICRO-TURN Lathe, described in Bulletin No. 219. Nebel Machine Tool Corporation, Lathe Division, 3407 Central Parkway, Cincinnati 25, Ohio.

*TM



RCA Whirlpool

Combination washer-dryer, one of the newest of a famous family of home appliances.

Workless Washdays Start Here

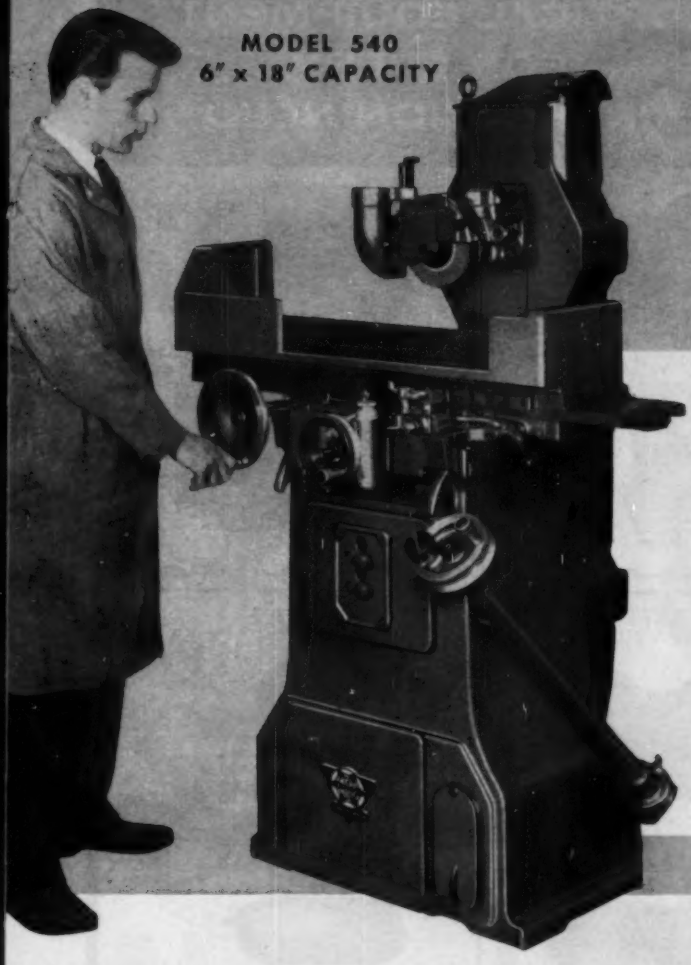
It's a long step from washday back to the Experimental Shop of the WHIRLPOOL CORP., at St. Joseph, Mich. But back there you'll find a battery of South Bend 16″ Toolroom Lathes hard at work turning out parts for the prototypes of tomorrow's appliances. The adaptability of South Bends to every type of operation gets work done quicker . . . their accuracy makes it right the first time . . . and their dependability keeps them on the job with fewer interruptions. Why not find out *now* how they can make your lathe work more efficient? Prices of 16″ Toolroom Lathes start at only $3230—time payment plan available.

SOUTH BEND LATHE

SOUTH BEND LATHE, INC.
SOUTH BEND 22, IND.

Builders of Lathes • Milling Machines • Shapers • Drill Presses • Pedestal Grinders

HYDRAULIC SURFACE GRINDER



MICRO MATIC
HONE CORPORATION
DETROIT, MICHIGAN
MANUFACTURED BY
JONES-SHIPMAN
LEICESTER, ENGLAND

ACCURACY... EFFICIENCY... EASE OF OPERATION

This machine has all the essential qualities required to provide high caliber surface grinding. Its simplicity of design provides ease of operation while inherent accuracy and efficiency assure excellent grinding performance. Thousands of these grinders have been purchased by discerning users in every part of the world.

FEATURES:

- Completely centralized controls within easy reach of operator.
- Patented low-pressure, long-life Hydraulic System operating from self-contained motor-driven pump unit.
- Table traverse rates variable from 5′ to 40′ per minute. Smooth and shockless reversing at maximum speeds.
- Cross-feed automatically variable from .01 in. to .07 in. per stroke.
- Hand controls provided for both traverse and cross-feed. Micrometer adjustment to cross-feed in .0001 in. divisions.
- Vertical adjustment of wheelhead controlled by conveniently placed handwheel having a micrometer knob adjustment in .0001 in. divisions.
- Wheelhead slide operates on ball bearing rollers running on precision ground bars providing absolute sensitivity of vertical feed.

Automatic vertical wheelhead feed and electric lift can be fitted to standard machine as an extra feature. Also, numerous other attachments including form tool grinding equipment are available to assure full versatility.

FOR FURTHER INFORMATION, WRITE FOR YOUR COPY OF BULLETIN C183.

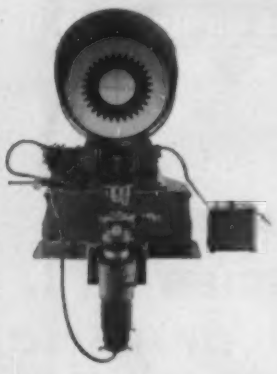
PRECISION PRODUCTION THROUGH MICROHONING
MICRO MATIC

MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE • DETROIT 38, MICHIGAN

NIKON

PRECISION OPTICAL EQUIPMENT FOR EVERY INSPECTION NEED



OPTICAL COMPARATOR—BENCH MODEL 2

OPTICAL COMPARATOR—FLOOR MODEL 3

OPTICAL COMPARATOR—BENCH MODEL 6

AUTO-COLLIMATOR—MODEL 1

AUTO-COLLIMATOR—MODEL 3

STEREO MICROSCOPE—MODEL SM2

STEREO MICROSCOPE—MODEL SM

BINOCULAR MICROSCOPE—MODEL SBR

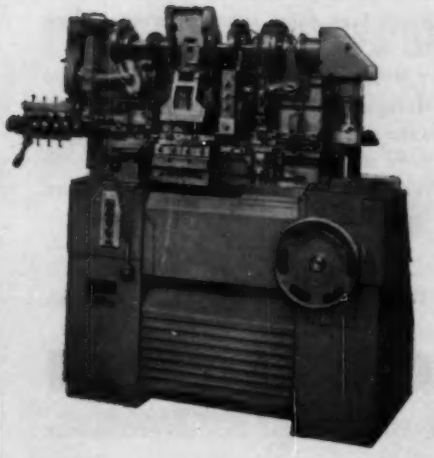
SIMPLE MEASURING MICROSCOPE

The above is only a partial listing of the many Nikon instruments designed to meet measurement and inspection requirements in production, quality control, intricate parts assembly, and other applications demanding fast, accurate inspection. For complete details, write to Dept. AM-10.

NIKON INCORPORATED
111 Fifth Avenue, New York 3, N. Y.

THESE PARTS ARE BEING PRODUCED AT SPEEDS OF 90 TO 250 PCS/MIN

PROFIT-TREE!



These are formed parts produced in single automatic operations on the revolutionary new Torrington Vertical 4-Slide.

With precision and speed, the Verti-Slide has replaced as many as five and six progressively tooled presses in the production of a complex part. Normal secondary operations such as welding are being done in one continuous automatic operation in excess of 100 pcs/min.

If you make or buy complex wire or strip parts, the Verti-Slide method offers dramatic reductions in production cost. Less parts handling, in process inventory, machine space—all mean greater profits to you.

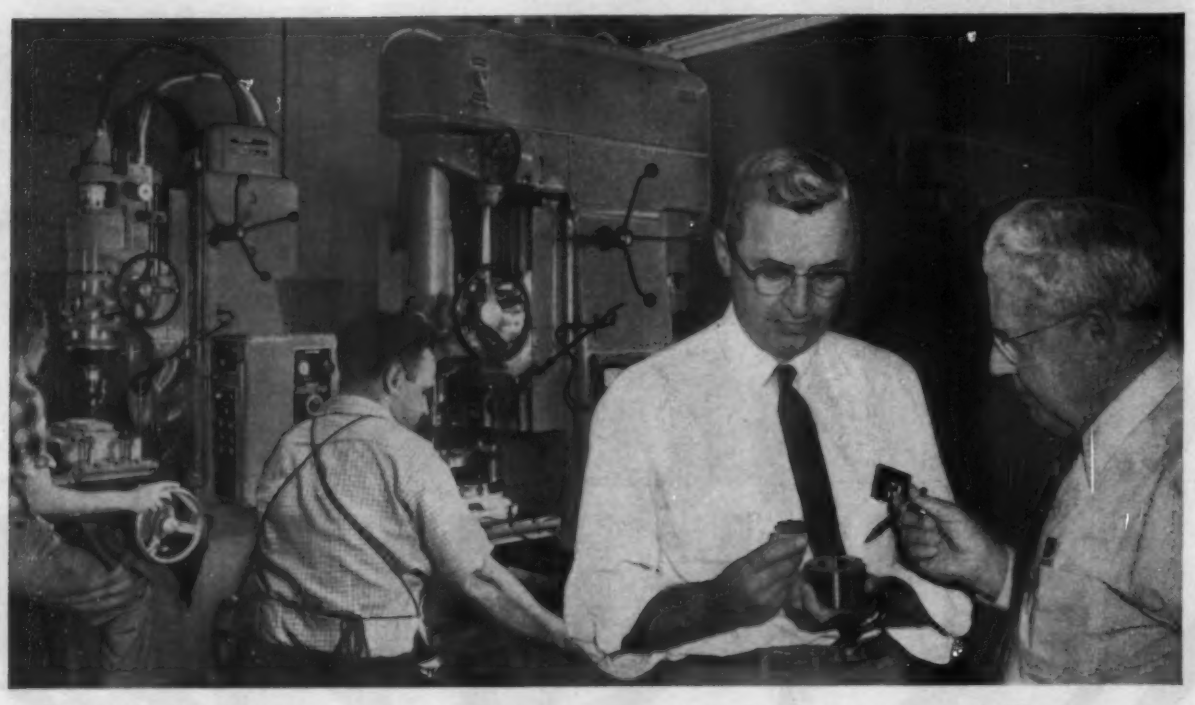
Write or call for field technical data or a Torrington Sales Engineer.

THE TORRINGTON MANUFACTURING COMPANY

MACHINE DIVISION Torrington, Connecticut

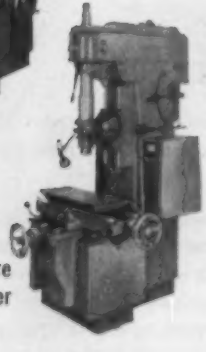
CIRCLE 346 READER SERVICE CARD

Herbert Harig, president, and Karl Harig, chairman, Harig Manufacturing Corporation, Chicago, examine tenth-splitting accuracy from their No. 3 Moore Jig Grinder (left) and No. 3 Moore Jig Borer.



"We're now splitting tenths, thanks to Moore's new No. 3 Jig Borer and Jig Grinder"

No. 3 Moore Jig Grinder



No. 3 Moore Jig Borer

Made and calibrated to the New International Inch.

"Our operators feel these are the best machines they have ever worked on... They take care of the tenth-splitting tolerances required by industry today."

These are the words of two of America's acknowledged tooling leaders, active heads of one of America's foremost independent producers of accurate dies—carbide, lamination, progressive, and other precision tooling.

Says Herb Harig, president of Harig Manufacturing Corporation and former president of National Tool & Die Manufacturers Association: "Moore's line of Jig Borers and Jig Grinders has been an integral part of the development of our company from 15 employees in 1937 to 120 today. We have always been among the first to install each new model. That's why we are among the first with Moore's tenth-splitting No. 3 Jig Borer and No. 3 Jig Grinder. Over the years we have enlarged our Moore Jig Boring and Jig Grinding Department to 15 machines!"

Sums up Chairman Karl Harig: "When owner-management invests its money in machinery, it does so only after thorough analysis and careful selection. I don't know of any machine manufacturer which meets both these tests better than does Moore."

We stand ready to help you duplicate Harig's record of satisfaction. As a start, write today for our detailed literature on these new tenth-splitting machines with larger tables; hardened, ground and lapped ways; no gibs, no overhang.

MOORE SPECIAL TOOL COMPANY, INC.
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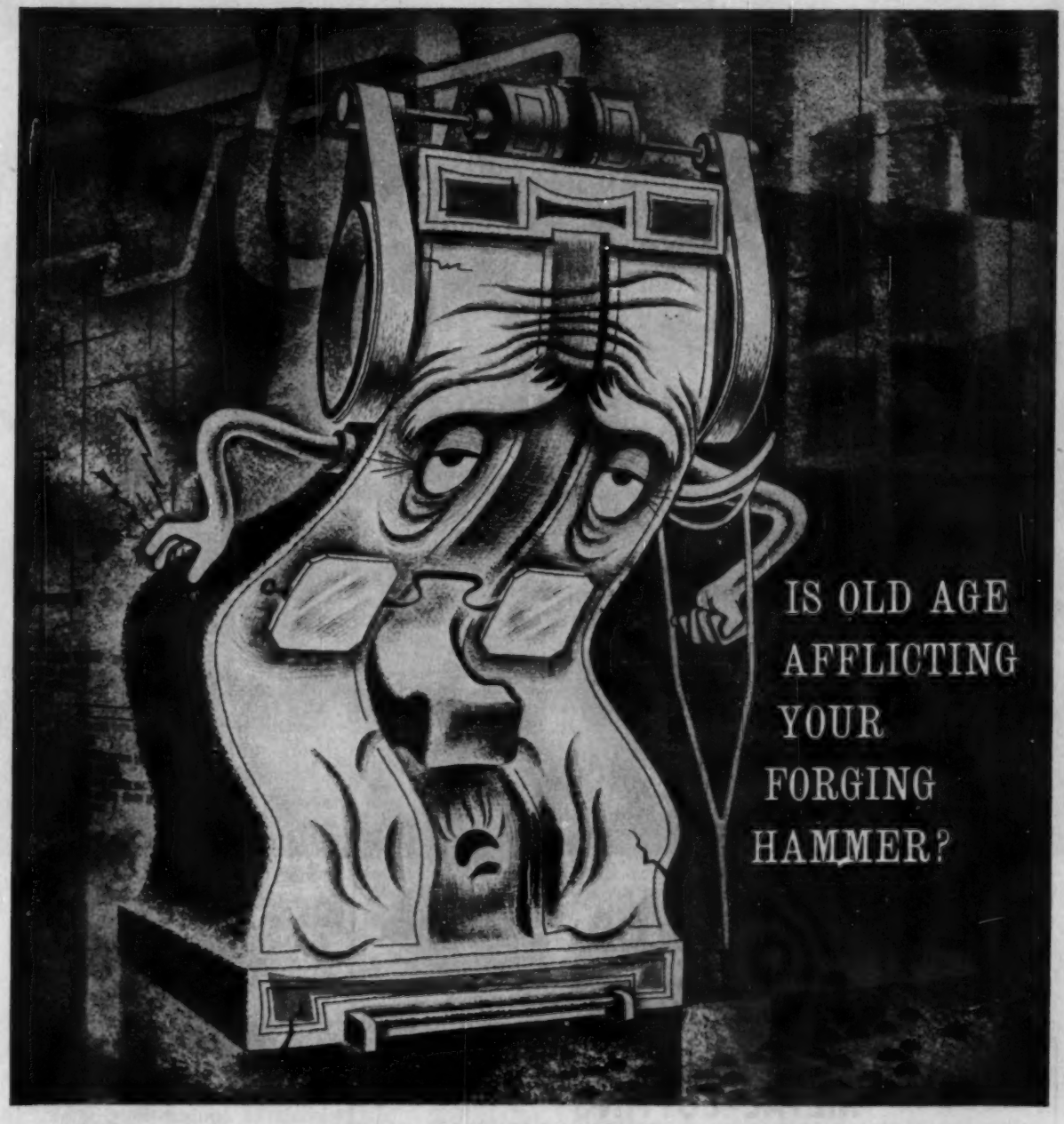
ADD MOORE TOOLS TO YOUR TOOLROOM

JIG BORERS • JIG GRINDERS • PANTOGRAPH WHEEL DRESSERS • PRECISION ROTARY TABLES • HOLE LOCATION ACCESSORIES



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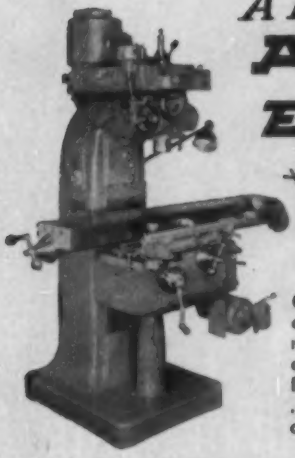
A Lot More **ACCURACY**

***ECONOMY** too!*

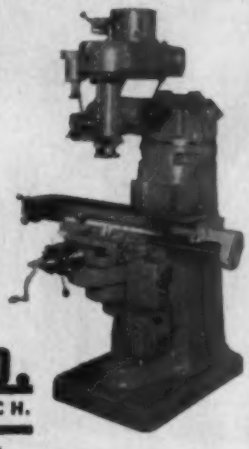


INDEX "SUPER 55" VERTICAL MILL

● 1½ HP Head or optional 2 HP with continuous duty motor gives 50% or more capacity . . . More rigidity, more accuracy . . . Increased horse power and dynamically balanced Cast Iron Pulleys and Drive System afford improved production capacity . . . More weight in the column, heavier ribbed column, heavier knee, heavier saddle.

INDEX "45" VERTICAL MILL

● Unique square design of overarm affords more rigidity, greater accuracy . . . Provides extra range and capacity . . . More power at the cutter. No adjustment required on overarm and head after use . . . No need to re-indicate head after moving overarm . . . Speed range with nine changes makes possible the use of high speed or carbide tipped cutters to best advantage.



INDEX MACHINE CO.

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CIRCLE 349 READER SERVICE CARD

METAL-CUTTING AT MORE THAN 100,000 SFPM?

Ultra-high speed machining is a subject that intrigues many production men in metalworking. The 16-page Special Report that AM/MM published in February, 1960, sums up recent development in the technique. If you'd like a copy, send 35¢ to

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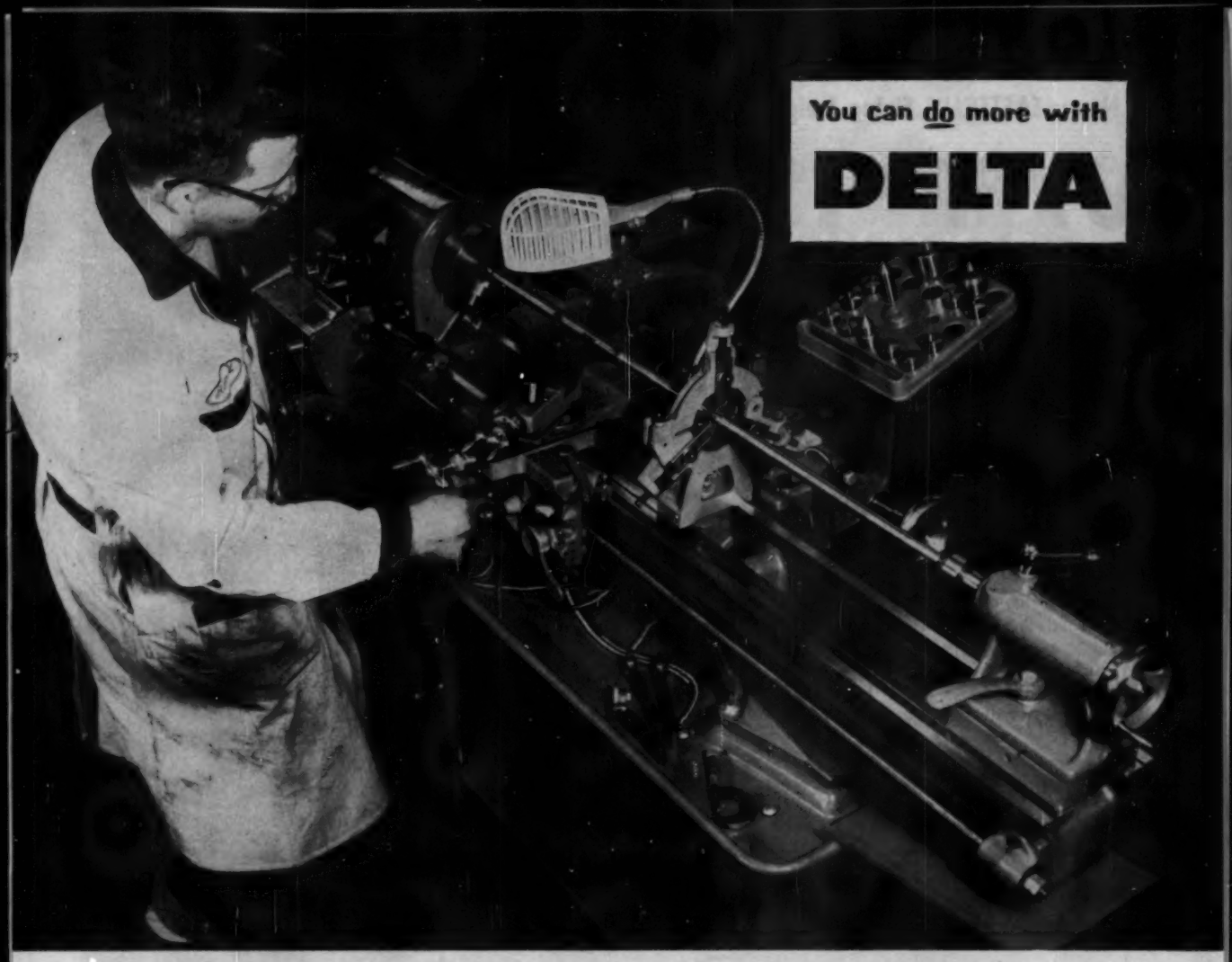

NEW 'Long Bed' 10" Metal Lathe offers capacity up to 36"

Delta 10" Metal Lathe with Long Bed (36" between centers) available in bench or cabinet models with a complete line of accessories.

Be sure to register and vote

Now Delta introduces the "big brother" to the famous 10" Metal Lathe—with a big 36" capacity between centers and an exclusive combination of features that make it the big value in its class.

This new model fills the need for a low-cost, precision lathe capable of handling heavy duty work in production, in plant maintenance shops and in tool rooms. In addition to extra capacity, it provides: variable speed drive with choice of speeds from 50 to 1500 rpm, quick change gear box allowing selection of 54 feed rates or thread pitches, and ¾" collet capacity—largest available in any comparable lathe.

See your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages) about the many other extra performance features you get. For FREE catalog describing the complete line of Delta Metal Lathes, write: Rockwell Manufacturing Company, Delta Power Tool Division, 618-K N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Box 420, Guelph, Ontario.

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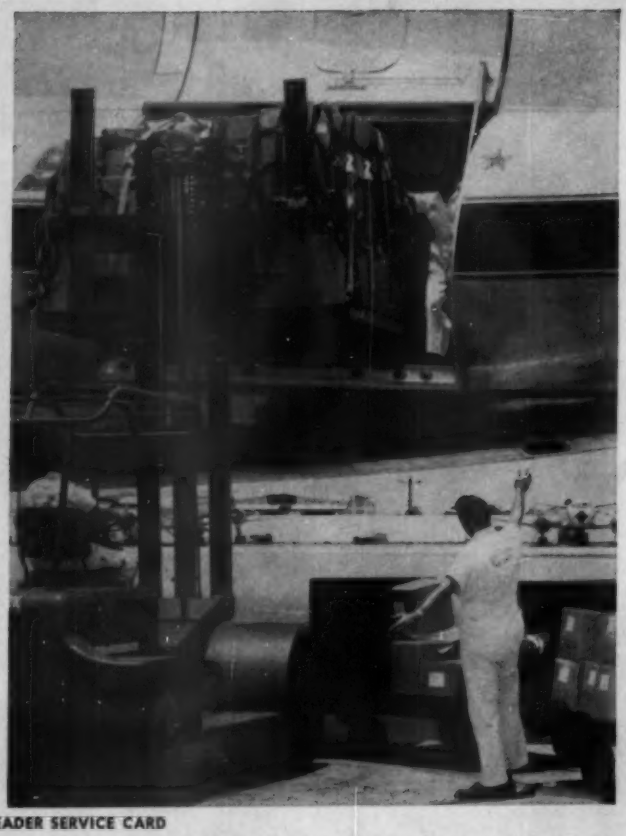
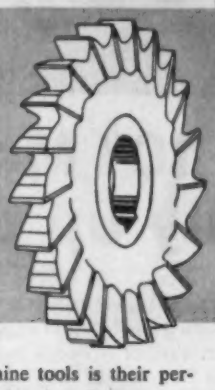


CIRCLE 353 READER SERVICE CARD

Better Tools From SENTRY Hardening



THE TRUE TEST of your machine tools is their performance on the job — how they benefit your production. This is where Sentry Furnaces with the Diamond Block method of atmosphere control demonstrate their value. Your high speed steel tools hardened in the truly neutral Sentry Diamond Block atmosphere achieve maximum hardness without scale or decarburization, maintain their sharp cutting edges longer, step up production.

Write for literature and send sample of your tools for free demonstration hardening.

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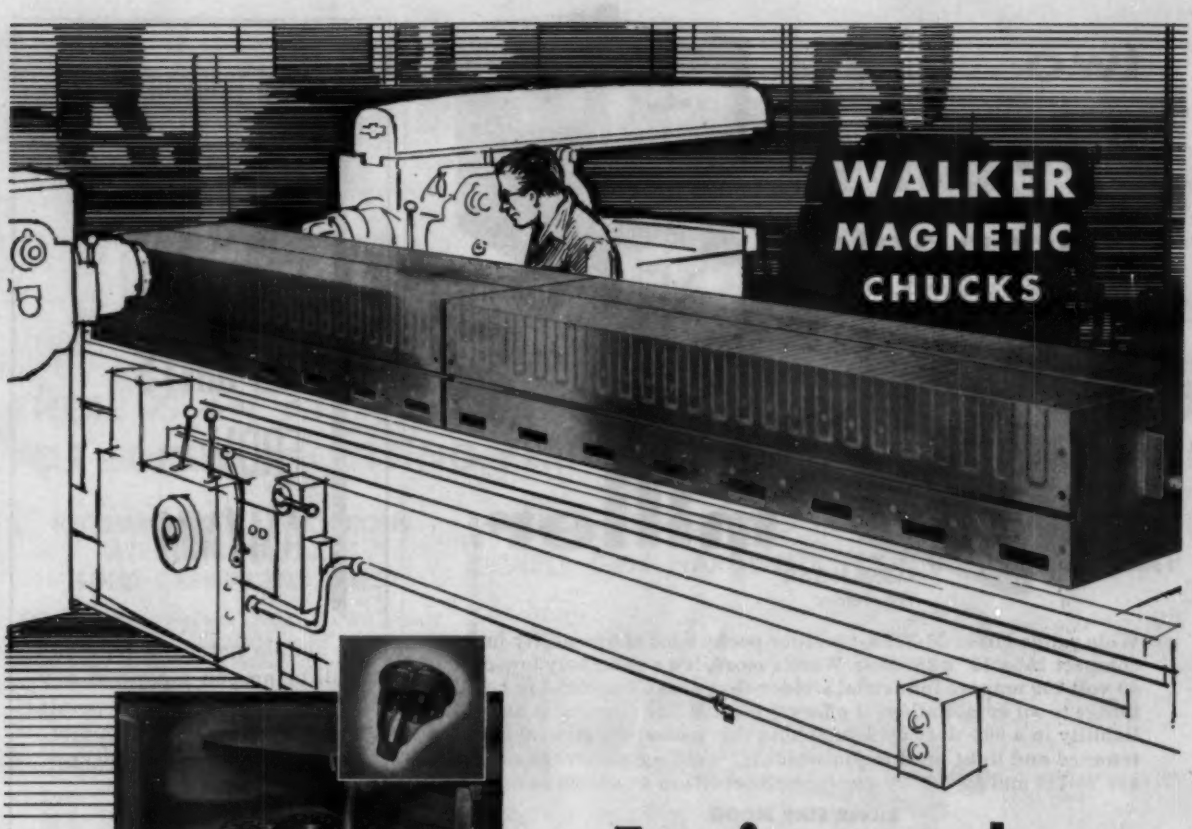
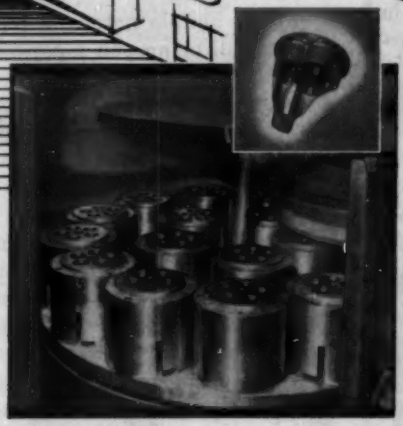
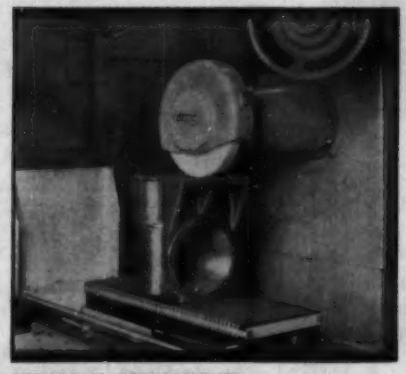
CIRCLE 355 READER SERVICE CARD





SPECIAL ROTARY
A special rotary auxiliary plate with cylindrical magnetic raising blocks holds irregularly shaped parts of grinding with quick easy set ups.



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A rugged Walker "Ceramax" chuck with ultra permanent ceramic magnets holds a large part for precision grinding.

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Walker engineers are continuously solving *new* holding problems for industry. The three-faced electromagnetic chuck above is only one example of the special designs created by Walker ingenuity and "knowhow". Whether you need any one of the complete line of standard magnetic chucks or a specially designed item, your best source is Walker.

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two new compacts from miller

Model M-295
a-c welder

Model H-3-SR
d-c welder

Wide range Miller M-295 a-c welder packs a lot of versatility in its compact 25" x 19" x 28" case. What's more, it's a genuinely low-cost 40 volt 200 ampere industrial welder that doesn't pretend to be all things to all men. Rather, it offers typical Miller sturdiness and reliability in a 60% duty cycle machine that's ideal for general maintenance and light production welding. Welding amperage ranges are 25-115 and 80-295. Power factor correction available as option.

SILVER STAR MODEL

Outsized performance has been built into this "inside" welder. Designed expressly to deliver the best in d-c welding at the lowest possible cost, the brand new Miller Silver Star performs on a par with the world's best (Miller's Gold Star SRH) but is less weather-resistant. If your d-c welding is done under a roof, then you'll want to know more about the Miller Silver Star, and the economies it offers. Two sizes available: H-3-SR with amperage ranges of 40-295 and 75-450; and H-4-SR with ratings of 50-350 and 100-600.

Complete information will be sent promptly upon request. Please specify model in which you're interested.

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CIRCLE 357 READER SERVICE CARD

WHAT ANGLES ARE BEST FOR OXIDE CUTTING TOOLS?

Recent experience shows that the geometry of carbide tools is not suitable for ceramic tools. Here's a 14-page reprint from AM/MM spelling out key points in tool geometry for oxide cutting tools. It's available for 35¢ from

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Material you can use

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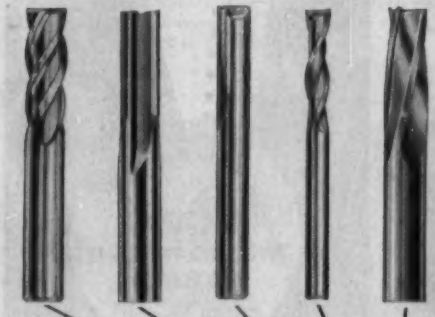
Job Applications

THERE IS AN ATRAX SOLID CARBIDE END MILL ENGINEERED FOR SUPERIOR CUTTING PERFORMANCE ON ANY MATERIAL!

RECOMMENDED APPLICATIONS ATRAX "STANDARD" SOLID CARBIDE END MILLS

202 different "standard" Atrax Solid Carbide End Mills in 20 different series, each engineered for a specific cutting application and recommended for specific materials.

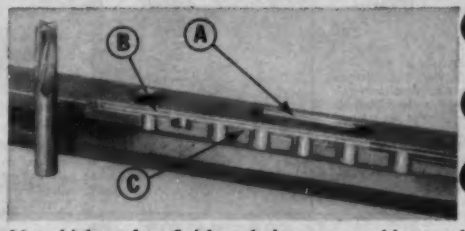
The most widely used Atrax End Mills and the materials on which they are engineered to perform best are shown in this table:



Material	Series 1501	Series 1502	Series 1503	Series 1504	Series 1505
Carbon Steels					X
Free Cutting Steels					X
Nickel					X
Nickel Chrome					X
Stainless Steels					X
Cast Iron		X	X		
Malleable Iron		X	X		X
Brass and Bronze	X				
Aluminum	X			X	
Zinc Alloy	X				
Copper	X				
Hard Rubber	X				
Fibre	X				
Plastics	X				
Monel Metal					X
Toughened & Heat Treated Steel					X
Hardened Steels					X
Titanium					X
Magnesium	X			X	

X—Preferences

TYPICAL SERIES 1505 PERFORMANCE ON ROCKWELL C-64 HARDENED TOOL STEEL WORKPIECE



A Elongating 3/8" slot, 1/16" deep at 700 rpm.

B Step cutting 3/16" wide—3/32" deep at 1150 rpm.

C Counter boring at 1150 rpm.

Note high surface finish and absence of burs and scoring. This Atrax 3/8" 1505 End Mill showed no appreciable wear land after completing three operations on this hard-to-cut material.

Note efficient, uniform chips with no burning and no chatter.

AN END MILL FOR EVERY APPLICATION

There is an Atrax "Standard" Solid Carbide End Mill job engineered for virtually every End Milling application. The Atrax Catalog gives engineering data on speeds, feeds, use of coolants and job hints that will further increase tool life production when you specify and use these superior Atrax Tools.

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THE ATRAX COMPANY

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Saves Set-Up Time— Increases Output

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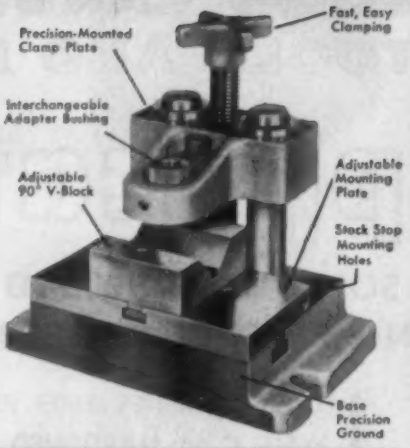
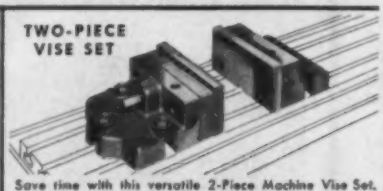


TRUE-CENTER ADJUSTABLE TOOL HOLDER

The REPCO Adjustable Holder is a precision-built tool, having two-piece construction which provides fast adjustment of the main body to compensate for as much as ⅛" machine misalignment. Cuts down on tool wear, breakage, and scrap.

TWO-PIECE VISE SET



Save time with this versatile 2-Piece Machine Vise Set. Use as general-purpose vise, angle-block, or separate clamping device. Opening limited only to length of machine base. Light, accurate, rigid. Two sizes: 6" and 8".

CHUCK JAW TRUING-RING SET

This Ring Set saves time, cuts cost of boring jaws. With correct diameter rings at hand, you gain hours of productive time. Plated rings range from 1" to 4" by ⅛" increments. Handy peg-type rack keeps rings in place.

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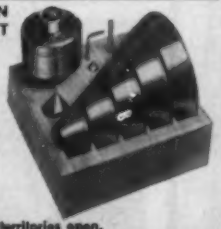
Heavy-duty live center plus six interchangeable adapters, ranging from a point to 6⅛" dia. bell. Saves costly set-up and machining time necessary to make large-diameter centers. Straight and various taper shanks available.



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EXPLOSIVE FORMING . . . HOW IT WORKS, WHAT IT DOES

One of metalworking's newest and most exciting developments, explosive forming is explored in a comprehensive 12-page reprint from AM/MM. The article, priced at 35¢, giving complete picture on developments may be secured from

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These strips are uniformly hardened to minimum 64 Rockwell C hardness and can be manufactured to your exact specifications, ready for application with Coes #945 Epoxybond adhesive or with holes for hold-down screws.

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CIRCLE 363 READER SERVICE CARD

Practical Tooling Tips

Number 1 of a series.

Everyday more and more shops are using standard Vlier Tooling Accessories in place of custom-made devices for both tooling and original equipment applications. The precision construction, product uniformity and quick availability of these simple time-savers have made them tool room favorites. Why don't you start saving from their use?

TO GET GREATER TOOL BIT RIGIDITY replace the tool holder screw with a Vlier Swivel-Pad® Clamp. The large, flat pad face provides many times more clamping area. Bits can be held tighter, reducing chatter and vibration. Small, narrow cut-off blades, multipoint tools, even stub ends can be rigidly held. Unique ball joint construction gives smooth angle adjustment in all directions.

EASY WAY TO STOP MARRING surface of part held in fixture. The part on the left was securely held in the fixture with a Vlier Swivel-Pad® Clamp. The scrapped part on the right was held with an ordinary set screw. With the Vlier Swivel-Pad® Clamp the pad stops at first contact with the part; screw torque is absorbed by a ball, preventing damage to the part. This exclusive ball joint construction also provides adjustment to off-angle surfaces.

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THE RIGHT AMOUNT OF END PRESSURE AND NO MORE is what this spring plunger application calls for. More than 150 Vlier Spring Plungers are used to hold a plastic sheet in position during the forming operation of a plastic refrigerator door liner. Spring Plungers provide just the right amount of pressure to produce a perfect liner.

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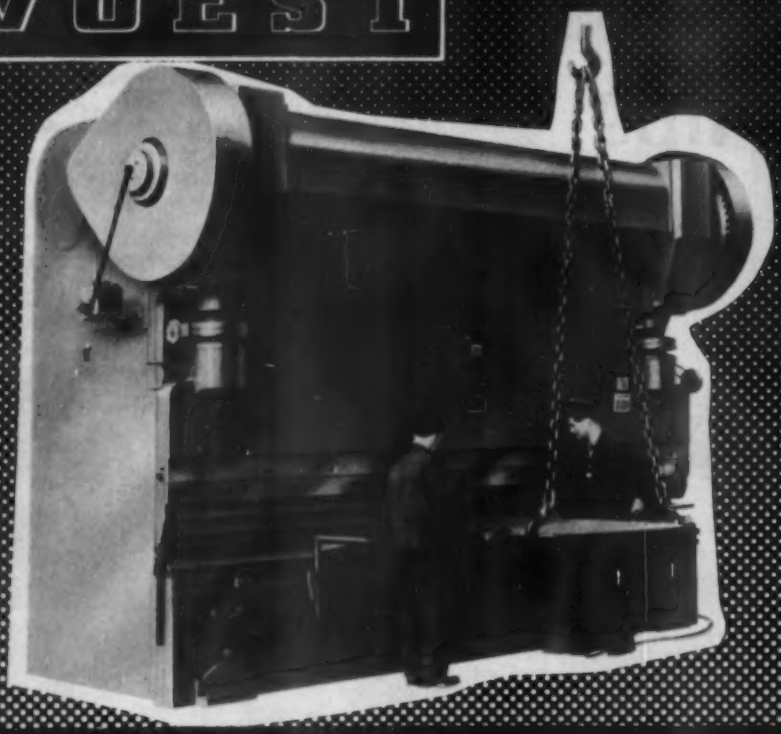
VÖEST



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Tubing, Pipe and Bar Stock

the Modern Way

Automatic operation—from loading to final cut-off. Handles solid bar stock up to 3" O.D.—tubing up to 8" O.D. Cuts any material that can be turned. 16 spindle speeds.

CATALOG

Has complete specifications of all models. Illustrates parts that are being formed, grooved, flanged or chamfered and cut off in a single operation at a high rate of speed. Also describes the automatic feeder, hot spinning machine for sealing ends of tubing, and the Modern Safety Drill Table.

108

WRITE

MODERN MACHINE TOOL CO.
2005 Losey, Jackson, Michigan

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Loyalty is a common trait among Jewel Brand Abrasive Belt users. Once you've tried them, it's easy to see why. Job after job, year after year, they never let you down. Try 'em and see!

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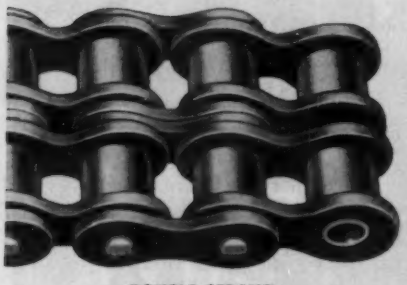
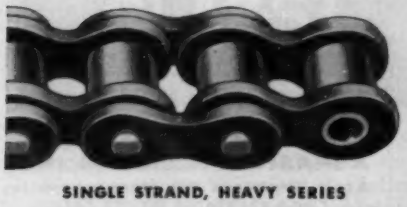
SINGLE STRAND

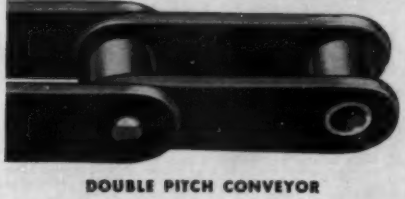


DOUBLE STRAND



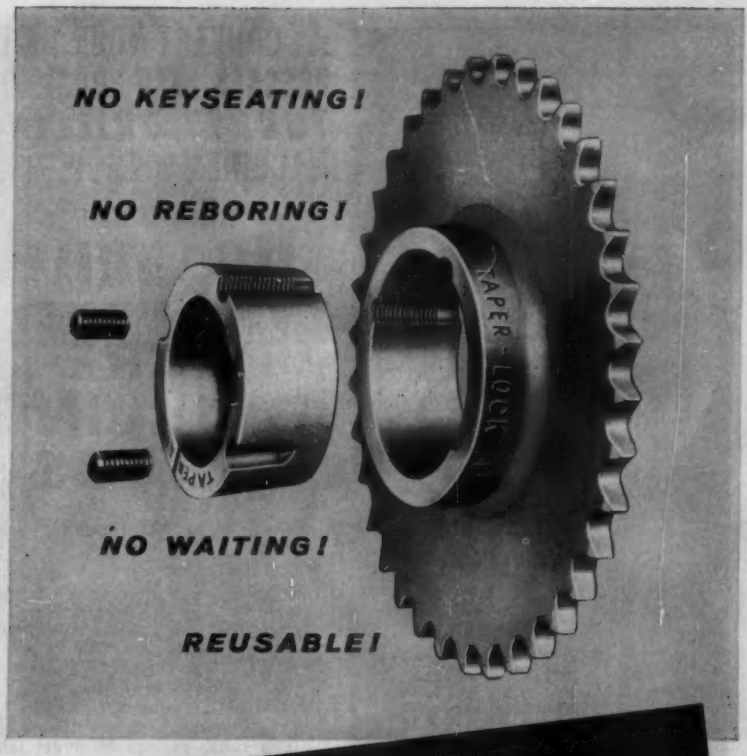
SINGLE STRAND, HEAVY SERIES

DOUBLE PITCH TRANSMISSION



DOUBLE PITCH CONVEYOR

DOUBLE PITCH CONVEYOR, LARGE ROLLERS



TAPER-LOCK SPROCKETS DODGE ROLLER CHAIN

DODGE Quality Roller Chain, teamed with Dodge Taper-Lock Sprockets, results in chain drives and chain conveyors that have the precision, efficiency and stamina necessary for the real economy of *long life*.

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CALL THE TRANSMISSIONEER—your local Dodge Distributor. Factory trained by Dodge, he can give you valuable help on new, cost-saving methods. Look under "Dodge Transmissioneer" in the *white* pages of your telephone directory, or in the yellow pages under "Power Transmission Machinery."

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5 Spindle Model Shown

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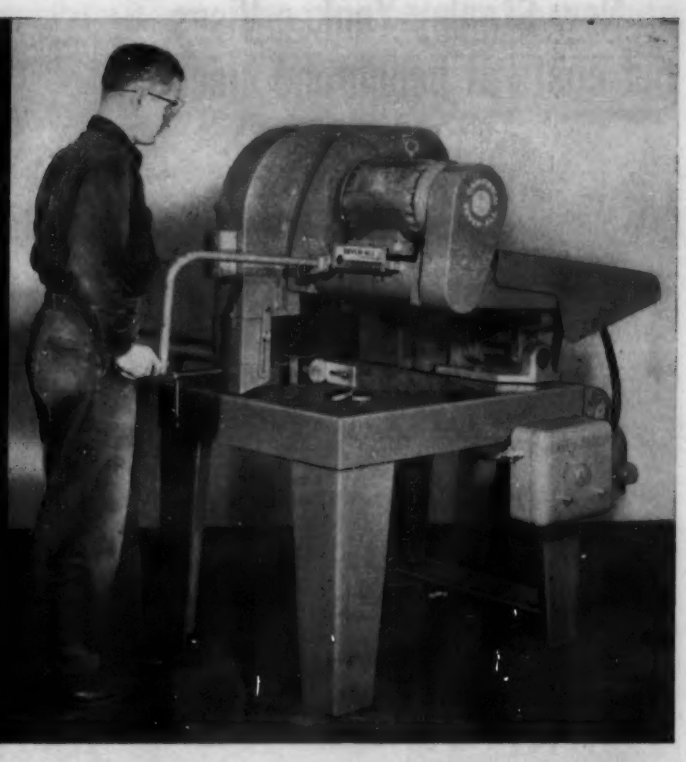
NEW!

GREATEST CUT-OFF CAPACITY IN ITS CLASS!



• This newest addition to the Sever-All line of abrasive cutting machines—the Model 2-A—provides greater cutting capacity and more flexibility than any other machine in its class. Check these important advantages:

Big capacity • cuts 4" round or square solids, 6" diameter tubing or standard pipe, 6" x 1" flat stock, 6" angle iron and 8" channels. Cuts practically all metals.

Fast operation • accurate cuts at the rate of 2 to 3 seconds per square inch. For instance, you can cut a 4" bar of hardened steel in 45 seconds, or a 2" pipe in 3 seconds.

Power oscillation • oscillation—the forward and backward motion of the cutting wheel as it is fed down into the cut—gives you extra cutting capacity without excessive horsepower load on your power lines. It also contributes to longer wheel life and reduced operator fatigue.

Quality cuts • clean, smooth cuts, even on large sections, because wheel oscillation provides cooler cutting action.

Economy • Sever-All abrasive cutting wheels, developed specially for the Model 2-A, assure you of lowest cost per cut.

Safe • wheel guard provides complete operator protection.

Minimum maintenance • all bearings are the pre-lubricated and sealed type. Clean, simple machine design permits easy housekeeping.

Built to last • rugged machine bed and rigid castings make the Model 2-A first choice for heavy-duty jobs.

VARIETY OF WORK HOLDERS GIVES UNUSUAL VERSATILITY

Choose the work holders you need from several optional arrangements. These include the vise-type holder shown on the machine at top, plus the V-block, angle-cutting and 2-way clamp fixtures above. All fit interchangeably on the Model 2-A Sever-All. Screw-type and quick-action clamping also may be used interchangeably.

***Write for details** on the new Model 2-A Sever-All abrasive cutting machine. Ask for Bulletin DH-299*

ACCO

SEVER-ALL ABRASIVE CUTTING MACHINES

Allison-Campbell Division, American Chain & Cable Company, Inc.

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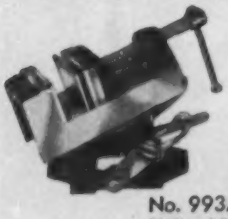
New Stanley-Yankee Vises cut costs at bench and machine



No. 4993A
Swivel-Tilt Vise
3" Jaws

No. 993A
Utility Vise
3" Jaws

New No. 4993A Swivel-Tilt Vise combines swivel base and angle base for quick compound angle set-ups. The exclusive dovetail slot in the vise permits adjustment the full length while retaining the swivel feature. Vise can be detached from swivel-tilt base quickly and easily.

New No. 993A Utility Vise with 3" Jaws—precision-built for machine shop use.

Vises and bases are available separately. Ask your industrial supply distributor for details, or write Stanley Tools, 9310 Elm St., New Britain, Connecticut.

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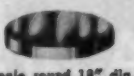

Single round 18" dia. table floats 5,000 lbs.

Rotary table 52" dia. floats 50,000 lbs.

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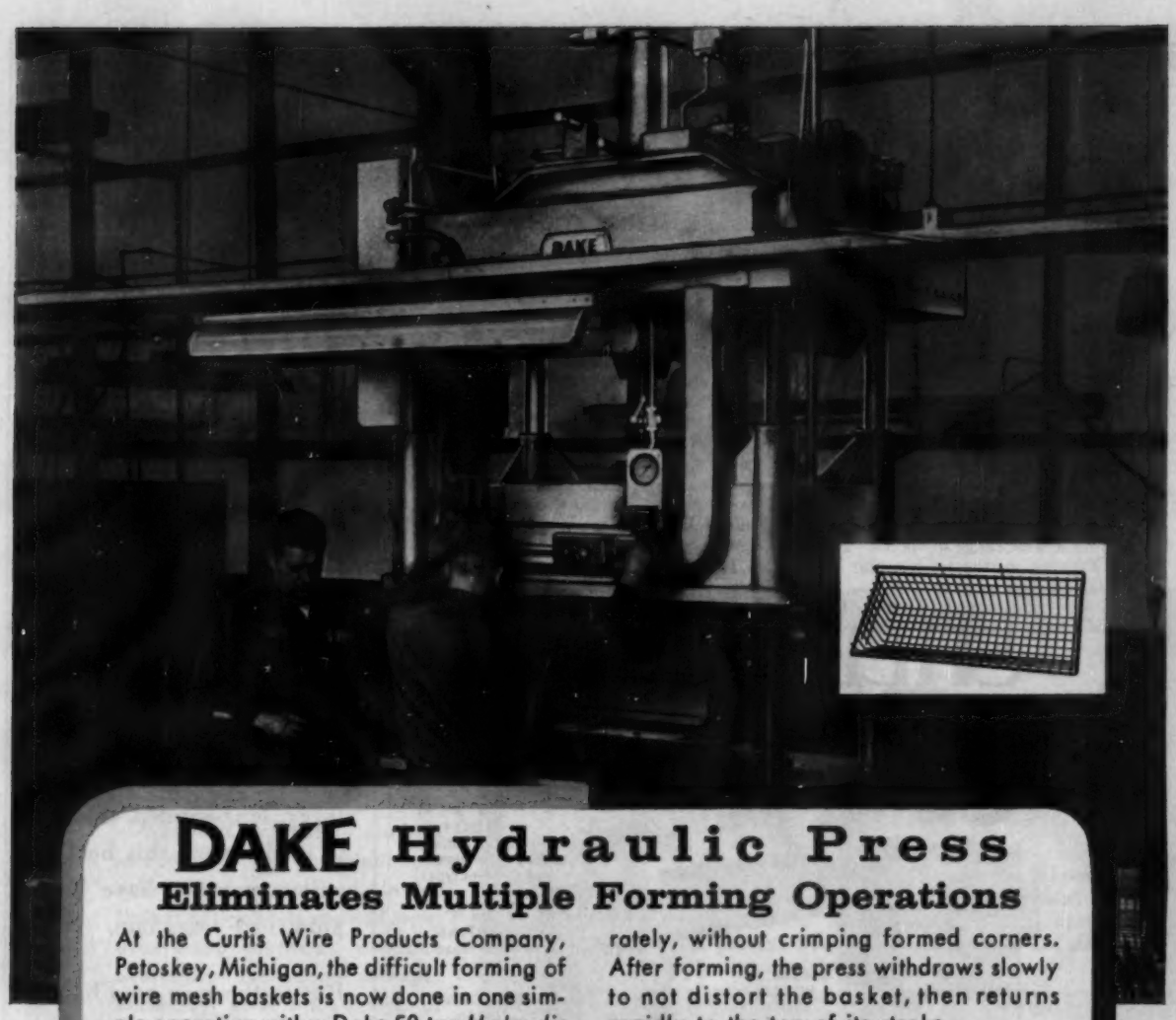

DAKE Hydraulic Press

Eliminates Multiple Forming Operations

At the Curtis Wire Products Company, Petoskey, Michigan, the difficult forming of wire mesh baskets is now done in one simple operation with a Dake 50-ton *Hydraulic* Guided Platen Press. The Dake Press saves considerable production time per basket by eliminating previous operations which formed only one side at a time.

The preset cycle of the Dake Press eliminates any possibility of operator error. After the wire mesh is placed in the die, the operator presses dual palm buttons which close the press rapidly until just before the wire mesh is contacted. It then slows to an adjustable pressing speed and forms the material smoothly and accurately, without crimping formed corners. After forming, the press withdraws slowly to not distort the basket, then returns rapidly to the top of its stroke.

Every feature of a Dake Press is designed to save production time. The press stroke may be set to eliminate unnecessary travel. Rapid advance and rapid return increase the pressing cycle. Large bed area with ample daylight provides easy insertion and removal of pressed parts.

Dake Presses are available in capacities from 25 to 600 tons. For special applications, investigate the Dake line of Custom-Engineered Presses. Write for Catalog.

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Movable Frame

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from to in seconds

or to *any* intermediate speed, *instantly*

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HOW TO WRITE BETTER REPORTS

To anyone who has ever fought his way through a foggy, long-winded, difficult to read report, this booklet will appear to have been published years late.

But to the man who has to write reports and would like to make them better, it's a handy working tool. A pocket-sized 26-pager, the booklet is authored by AM/MM Associate Editor Tom Johnson—a man trained in simplifying extremely complicated subjects.

You can secure a copy for 50c from Reader Service Department

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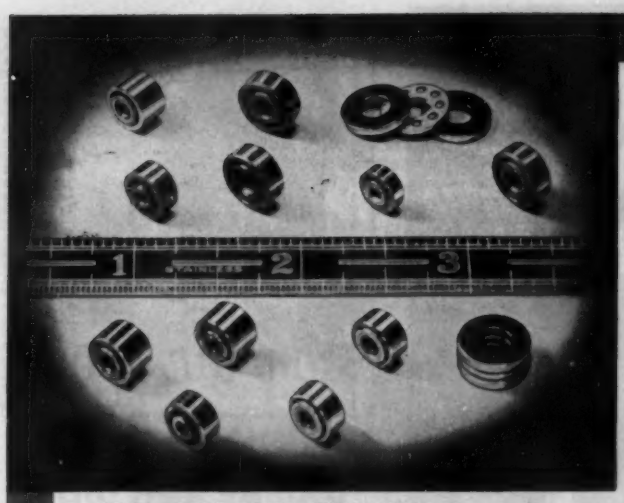

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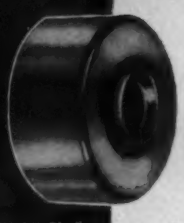

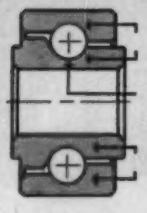

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No. 7261H—Cam follower roller on circuit breaker arm of data processing machine . . . a small but vital component. An example of Unibal construction, its small size belies its ruggedness and durability under tough operating conditions.

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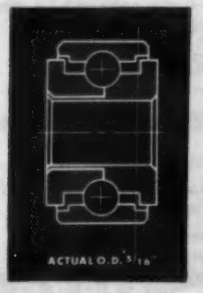
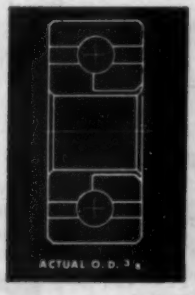
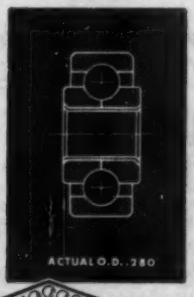
No. 6035-1 — Rear support bearing for print wheel carriage on electronic potentiometer.



No. 6034-1 — Idler clutch bearing on 8 mm motion picture projector.



No. 6713 — Gear support bearing in parking meter mechanism.



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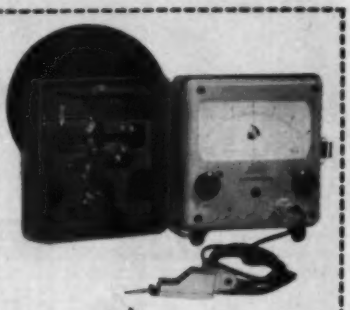

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2959

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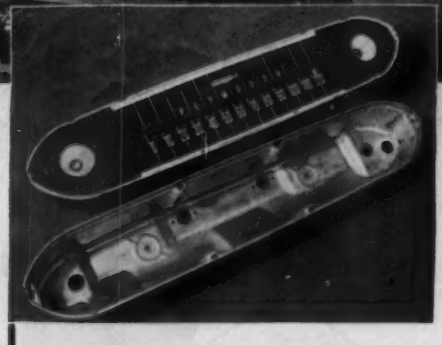
From coil stock, this 300 ton Verson Transmat Press produces 1200 automotive speedometer housings per hour automatically for Stewart-Warner Corporation, Chicago, Ill.

The press performs seven operations on the piece which measures 18″ long x 3¼″ wide x 2⁹⁄₁₆″ in height in the finished form. The press utilizes a mechanically actuated Transmat feed for automatically handling the stamping through all die stations. The feed is protected, in event of an overload, by safety slip clutches on the power take-off shaft and on the feed bar finger racks.

The press is equipped with an *Alemite* grease lubrication system for counterbalance and knockout rods and cushion guides. An *Alemite* automatic oil lubrication system handles the counterbalance, knockout and cushion packings.



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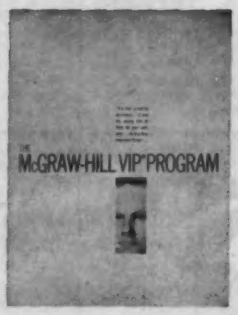

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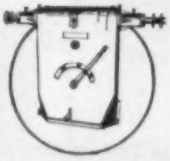
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2. Automatics
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7. Broaching Machines
13. Cutting Off Machines
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36. Milling Machines
40. Planers
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44. Presses
51. Saws
52. Services
53. Shapers
54. Shears
63. Welding Equipment

ADVERTISER	Page No.	KEY TO PRODUCTS OR SERVICES
Acme Gear Co., Inc.	274	30
Cincinnati Machinery Co.	274	6, 16, 25, 30, 40
Cook County Machinery Co.	274	19, 32
Eastern Machinery Co.	274	16, 25
Falk Machinery	274	6, 16, 25, 30, 36, 51, 53, 54
Hyman & Sons, Joseph	273	43, 44, 54
Midwestern Machinery Co.	274	2, 16 24, 25, 30, 31, 36, 44, 51, 53, 63
Miles Machinery Co.	273	2, 6, 7, 13, 16, 24, 25, 27, 29, 30
O'Connell Machinery Co.	274	6, 16, 30, 35, 36, 40, 44, 52
Twist Drill Sales Co., Hayden	274	16
Wigglesworth Machinery Co.	273	44

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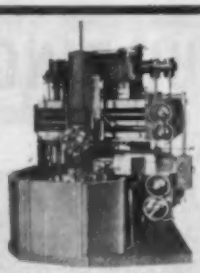

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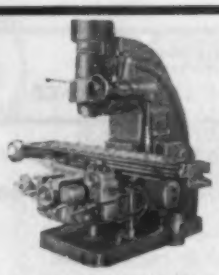

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¼"x40" Bausch Double Horizontal Drilling Machine, m.d.
No. 445 W.F. & John Barnes Independent 2 spindle Deep Hole Drill & Boring Machine, late
No. 2F1 Natco Horizontal Boring & Drilling Machine
Natco, Holostool Model, m.d.
Natco Horizontal Drill, 2 opposed B4F2 Head, 1943
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M-24 KEARNEY & TRECKER Auto. Prod. Mill.
No. 3V VAN NORMAN Ram Type Vert. Mill.
No. 3K K & T Horiz. Mill, Late Type, M.D.
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12" ROCKFORD Vert. Hyd. Slotter, 1951.
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6' x 14 Ga. WYSONG & MILES Power Shear.

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	Page
Abrasive Products, Inc.	252, 258, 260
Ace Drill Corporation	190
Airborne Instruments Laboratory	266
Air Express Div. Railway Express Agency	234-235
Ajax-Magnathermic Corporation	197
Alco Products, Inc.	153-156
Allegheny-Ludlum Steel Corporation	50
Allen-Bradley Company	127, 128
Allison-Campbell Div. American Chain & Cable Co., Inc.	261
Aluminum Company of America	63, 219
American Brass Company	40-41
American Chain & Cable Co., Inc. Allison-Campbell Div.	261
American Schiess Corporation	240
American Sip Corporation	3rd Cover
American Steel & Wire	36-37
American Steel Foundries Elmes/King Div.	179
American Stock Gear Div. Perfection Gear Co.	170
American Tool Works Company	43
Ames Company, B. C.	280
Anocut Engineering Company	177
Armstrong Blum Manufacturing Co.	16
Armstrong Brothers Tool Company	32
Atlas Press Company Clausing Div.	217
Atrax Company	255
Austin Industrial Corporation	194
Avey Division of Motch & Merryweather Machinery Co.	38
Baird Machine Company	188
Barber-Colman Company	66-67
Bay State Abrasive Products Company	79-82
Bay State Tap & Die Company	233
Bethlehem Steel Company	75
Blanchard Machine Company	242
Bliss Company, E. W.	223
Bodine Corporation	171
Boice-Crane Company	276
Boston Gear Works	169
Brown & Sharpe Manufacturing Co.	48
Bryant Chucking Grinder Company	130
Buck Tool Company	278
Buffalo Forge Company	58
Bullard Company	86
Butterfield Division Union Twist Drill Co.	46
Cadillac Gage Company	231
Chambersburg Engineering Company	168
Chandler Tool Company	272

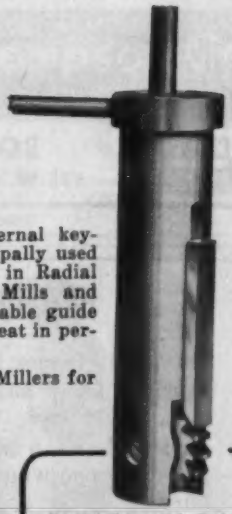
(Continued on page 276)

YOU CAN FIND IT QUICKER AND EASIER IN SWEET'S MACHINE TOOL CATALOG FILE

CIRCLE 397 READER SERVICE CARD

THE KEY TO BETTER KEYSEATS

NATIONAL
Keyseating Millers



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INDEX TO ADVERTISERS

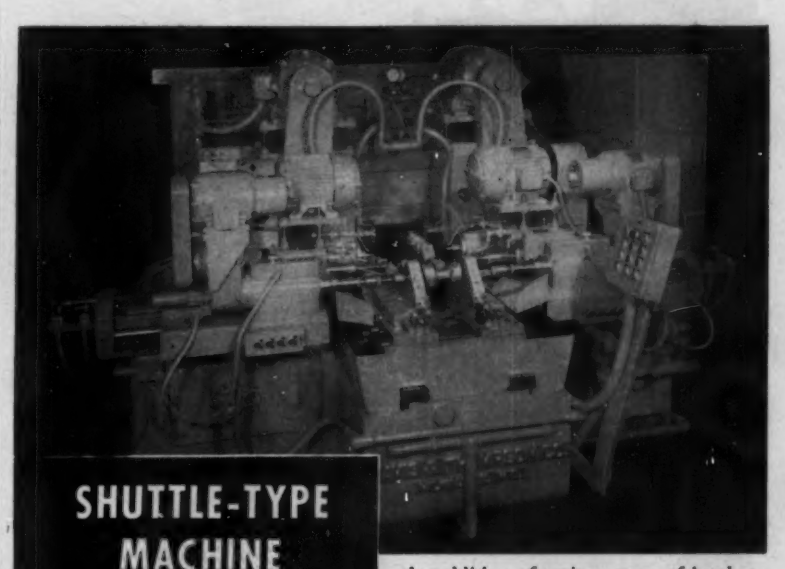
(Continued from page 275)

	Page
Chicago Quadrill Company	260
Chicago Screw Company	42
Cincinnati Gilbert Machine Tool Co.	98
Cincinnati Milling Machine Co. Cimtrol Division	5, 6-7
Cincinnati Shaper Company	26-27
Circo Corp.	180-181
Circular Tool Company Inc.	232
Clausing Division of Atlas Press Company	217
Cleveland Crane & Engineering Co.	182-183
Coes Knife Company	256
Columbia Geneva Steel	36-37
Continental Tool Works Div. Ex-Cell-O Corpcration	97
Coromant Sales Division Sandvik Steel Inc.	279
Cross Company	20-21
Crucible Steel Co. of America	68-69
Cushman Chuck Company	90
Cutler-Hammer Inc.	210-211
Dake Corporation	263
Davis & Thompson Company	277
Dearborn Gage Company Ellstrom Standards Div.	228
Delta Power Tool Division Rockwell Manufacturing Co.	251
DeVilbiss Company	190
Diehl Manufacturing Company Sub. Singer Manufacturing Co.	225
Disston, Henry, Div. of H. K. Porter Company, Inc.	224
Dodge Manufacturing Corporation	259
du Mont Corporation	74
Eastern Air Lines Air Freight	252
Eaton Manufacturing Co. Automotive Gear Div.	184
Elgin National Watch Co. Abrasives Div.	198
Erie Foundry Company	249
Ex-Cell-O Corporation	97
Federal Products Corporation	189, 191
Fellows Gear Shaper Company	8-9
Felters Company Unisorb Div.	200
Foote Gear Works, Brad Sub. Pittsburgh Gear Co.	204
Friden Inc.	51
Gallmeyer & Livingston Company	218
General Electric Company	173, 174
Giddings & Lewis Machine Tool Co.	59-62
Gisholt Machine Company	31
Gleason Works	167
Goss & de Leeuw Machine Company	206
Grant Manufacturing & Machine Co.	277
Greaves Machine Tool Company	230

INDEX TO ADVERTISERS

	Page
Greenlee Brothers & Company	88
Grieder Industries, Inc.	262
Hamilton Tool Company	268
Hanson-Whitney Company	226
Hardinge Brothers, Inc.	57
Hartford Machine Screw Company	42
Heald Machine Company Sub. Cincinnati Milling Machine Co.	2nd Cover
Heller Tool Co. Subsidiary Simonds Saw & Steel Co.	30
Index Machine Company	250
Ingersoll Milling Machine Company	100
Innocenti	55
Jahn Manufacturing Co., B.	220
Jarvis Corporation	77
Johnson & Son, Inc., S. C.	129
Jones & Lamson Machine Company	47, 159, 161, 163, 165
Jones & Laughlin Steel Corporation Stainless & Strip Division	52, 53
Kennametal, Inc.	146
Kent-Owens Machine Company	212
Kingsbury Machine Tool Corporation	239
L & J Press Corporation	266
Landis Machine Company	10-11
Landis Tool Company	12-13, 17
LaPointe Machine Tool Company	22-23
Lincoln Electric Company	72-73
Linde Co., Div. Union Carbide Corporation	236-237
Linley Brothers Company	188
Lucas Machine Division New Britain Machine Company	33, 34
Macco Products Company	201
Madison Industries Inc.	196
Manhattan Rubber Div. Raybestos-Manhattan, Inc.	148
M.B.I. Export & Import Ltd.	176
McGill Manufacturing Company	241
Metallurgical Products Dept., General Electric Company	39
Micromatic Hone Corporation	245
Micro Switch, a division of Honeywell	238
Milford Rivet & Machine Company	175
Miller Manufacturing Company	254
Mobil Oil Company	28-29
Modern Machine Tool Company	258
Monarch Machine Tool Company	24-25
Moore Special Tool Company, Inc.	248
Morse Twist Drill & Machine Company	84
Mueller Brass Company	186-187
National Broach & Machine Company	134
National Machine Tool Company	275
National Tube	36-37

(*Continued on page 278*)



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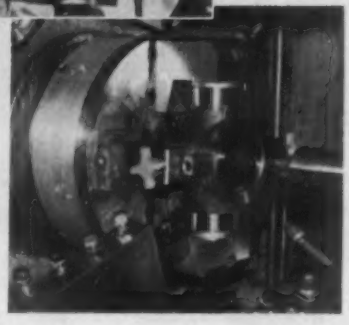

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INDEX TO ADVERTISERS

(*Continued from page 277*)

	Page
Nebel Machine Tool Corporation	243
Nelco Carbide Cutting Tools	48
New Britain Machine Co., The Lucas Machine Division	33, 34
Niagara Machine & Tool Works	132
Nice Ball Bearing Company	265
Nikon Incorporated	246
Norton Company	18-19
Oakite Products, Inc.	216
Ohio Crankshaft Company	157
Ohio Seamless Tube Div. Copperweld Steel Company	205
Optical Gaging Products, Inc.	195
Osborn Manufacturing Company	178
Peck Stow & Wilcox Company	172
Perfection Gear Company American Stock Gear Div.	170
Philadelphia Gear Corporation	144
Railway Express Agency Air Express Div.	234-235
Raybestos-Manhattan Inc.	148
Republic Steel Corporation	14-15
Roberts Rubber Co., Weldon	230
Rockford Engineered Products Co.	256
Ryerson & Son, Inc., Joseph T.	92
Seneca Falls Machine Company	222
Sentry Company	252
Sheffield Corporation of Bendix Corp.	35
Sheldon Machine Company	264
Shell Oil Company	221
Shepard Niles Crane & Hoist Corp.	213
Simonds Saw & Steel Company	94
Sinclair Refining Company	227
Skinner Electric Valve	207, 208
South Bend Lathe Inc.	244
Square D Company	199
Standard Screw Company	42
Stanley Works	262
Starrett Company, L. S. The	136
Steelweld Machinery Division Cleveland Crane & Engineering Co.	182-183
Stocker & Yale Inc.	270
Sundstrand Machine Tool Company	70-71
Sweet's Catalog Service	275
Tennessee Coal & Iron	36-37
Textile Machine Works	54
Thompson Grinder Company	229
Thomson Electric Welder Company	202
Timken Roller Bearing Company Steel & Tube Div.	4th Cover
Torit Manufacturing Company	192
Torrington Manufacturing Company	247
Turchan Follower Machine Company	202
Twin Specialty Oil Company	49

INDEX TO ADVERTISERS

	Page
Union Carbide Corporation Linde Division	236-237
Union Manufacturing Company	262
United Austrian Iron & Steel Works	258
U. S. Electrical Tool Company	272
United States Steel Company	36-37
United States Steel Export Company	36-37
United States Steel Supply	36-37
Universal Engineering Company	78
Valenite Metals Div. of Veleron	193
Vanadium-Alloys Steel Company	203
Van Keuren Company	76
Verson Allsteel Press Co.	269
Vickers, Inc.	44-45
Vlier Engineering Corporation Sub. Barry Controls Inc.	257
Wade Tool Company	267
Walker Company, Inc., O. S.	253
Warner & Swasey Company	64-65
Weldon Tool Company	215
Western Automatic Machine Screw Co.	42
Wheelock Lovejoy & Co., Inc.	209
Wichita Clutch Company	56
Wyckoff Steel Company	214
Yoder Company	232

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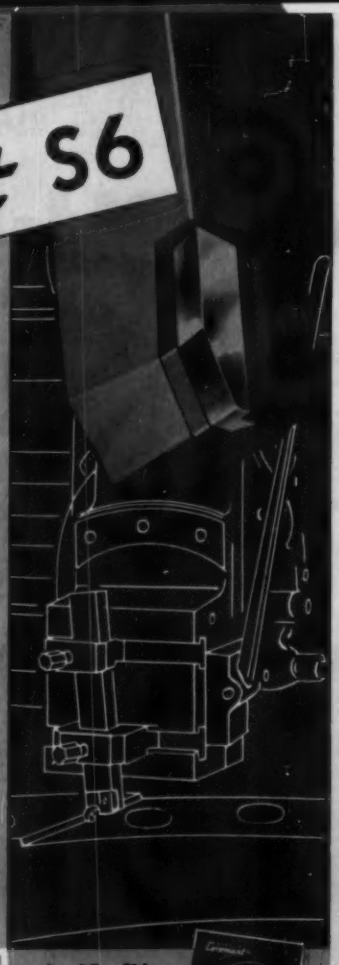

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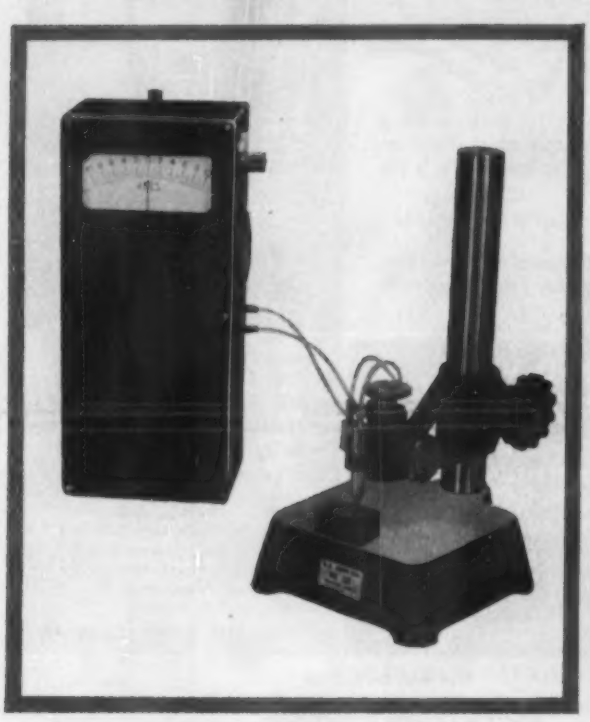

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78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103
104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124
125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145
146 147 148 149 150
540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560
561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581
582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600

ADVERTISEMENTS

151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166
167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187
188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208
209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224
225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245
246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266
267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287
288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308
309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329
330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371
372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392
393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413
414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434
435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455
456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476
477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497
498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518
519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539

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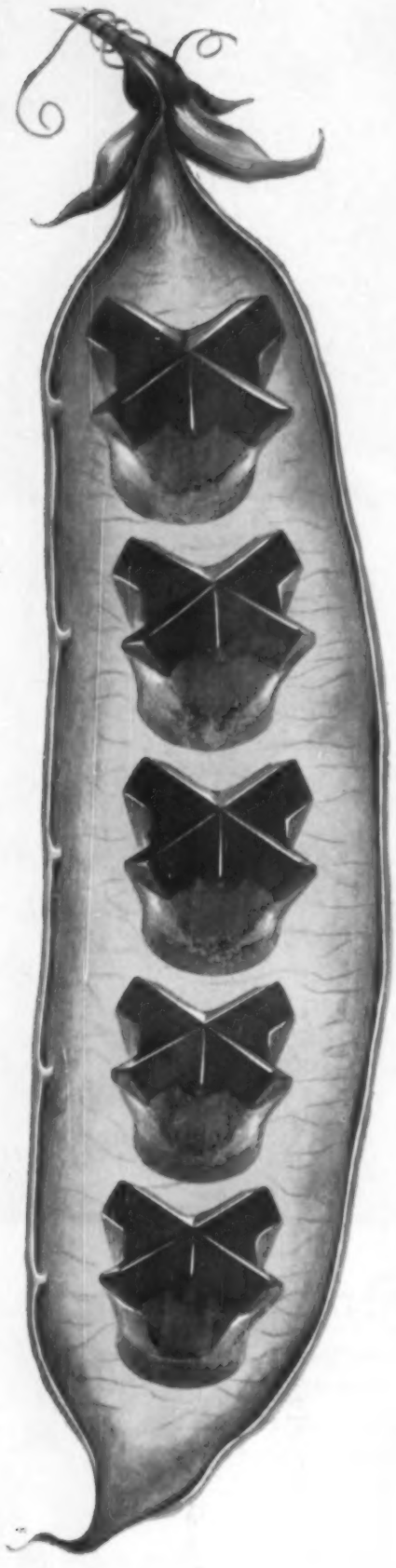

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